United Nations S/2006/420

Security Council

Distr.: General
21 June 2006

Original: English

United Nations Monitoring, Verification and Inspection Commission

Note by the Secretary-General

The Secretary-General has the honour to transmit to the Security Council the summary of the compendium of Iraq's proscribed weapons programmes in the chemical, biological and missile areas. It has been prepared by the United Nations Monitoring, Verification and Inspection Commission (UNMOVIC) and is submitted by its Acting Executive Chairman.

06-39907 (E) 190706

Summary of the compendium of Iraq's proscribed weapons programmes in the chemical, biological and missile areas

June 2006

Foreword

The United Nations experience in the disarmament of Iraq of its weapons of mass destruction (WMD) and dismantlement of related programmes is unique. After the conclusion of the Gulf war, in 1991, the United Nations Security Council adopted a series of resolutions under Chapter VII of the Charter of the United Nations related to the Iraq-Kuwait conflict, including the creation in April of a United Nations inspection commission as a subsidiary body of the Council. It was the first time that an international inspection regime was authorized to destroy, render harmless or remove all facets of a country's proscribed chemical, biological and missile programmes and to conduct subsequent monitoring to deter their revival.

In carrying out its mandate, the United Nations Special Commission (UNSCOM) was provided with unprecedented rights of access to Iraq's relevant facilities, personnel, documents and other materials. Despite varying degrees of cooperation from the Iraqi authorities at the time, the United Nations inspectors successfully oversaw the destruction, removal or rendering harmless of Iraq's declared WMD programmes in the chemical, biological and missile areas. The Commission also implemented a monitoring system which essentially ensured that proscribed programmes were not revived while international inspectors were present.

In order to implement its mandate effectively, a comprehensive set of inspection procedures and practices were developed. These included the use of satellite, high, medium and low altitude aerial imagery as well as ground photography, state of the art equipment for analysing chemical and biological samples, equipment designed for the drilling and sampling of munitions filled with live chemical or biological agents, computer forensics, ground penetrating radar, remote monitoring and many other inspection tools used for the first time in an inspection and verification process. In addition, an effective import/export monitoring system was introduced for dual-use items and materials which provided a high degree of confidence that they were not diverted to any proscribed activity. Special measures were introduced in the transfer, storage and use of classified and sensitive information.

During 2005, UNMOVIC embarked on the preparation of a compendium of Iraq's proscribed weapons programmes in the chemical, biological and missile areas. Issues concerning the Iraqi nuclear weapons programme are not addressed since they fall within the competence of the International Atomic Energy Agency (IAEA). As the document is rather voluminous and contains proliferation and other sensitive information that could not be released to the public, it was decided to prepare the present summary document. This summary of the compendium provides a broad view of the establishment, evolution and operation of the Commission in Iraq with due regard to proliferation concerns about sensitive information. It covers the history of the proscribed Iraqi programmes in the chemical, biological and

missile areas, the links between them, as well as the organizational structure and systems of procurement that supported these programmes. Included are lessons that can be drawn from both the nature of the programmes and the experience gained in the process of verification by United Nations inspectors.

Contents

		Page
	Foreword	2
	Abbreviations	6
I.	Building a United Nations verification regime	7
	A. Forming the United Nations Special Commission in 1991	7
	B. Support from Member States	9
	C. Developing verification practices and procedures	12
	D. Establishment of the United Nations Monitoring, Verification and Inspection Commission in 1999	15
	E. Further development of the verification system	18
	F. Major achievements	19
II.	Organizational structure of Iraq's proscribed weapons programme	21
	A. Scope of proscribed weapons programmes	21
	B. Mapping the organizational structure	22
	C. Iraq's military industries and proscribed programmes	24
	D. Military industries and human resources	28
	E. Importance of investigation of the organizational structure	28
III.	Iraq's procurement for its weapons of mass destruction programme	30
	A. Scope and role of procurement from the 1970s to 1990	30
	B. Sanctions and procurement	37
	C. Importance of procurement verification	40
IV.	Iraq's chemical weapons programme	40
	A. Overview	40
	B. Weaponization of chemical warfare agents	43
	C. Destruction of Iraq's chemical weapons and related items	45
	D. United Nations verification	45
V.	Iraq's missile-related programmes	48
	A. From imported foreign missiles to indigenous missile projects	48
	B. Expansion of indigenous missile projects	51
	C. The 1991 Gulf war and the adoption of Security Council resolution 687 (1991)	53
	D. United Nations verification	54
	E. Ongoing monitoring of missile activities in Iraq	55
	F. Hiatus and resumption of missile monitoring and verification activities	56

VI. Iraq's biological weapons programme 59

A. Development of the biological weapons programme 59

B. The 1991 Gulf war and United Nations verification 62

VII. The compendium 68

List of charts

1. Organizational structure of Iraq's military industries in 1990 27

2. Mechanics of Iraq's procurement for its weapons programmes from the 1970s to the mid-1980s 31

3. Iraq's procurement through brokers and middlemen from the mid-1980s to 1990 33

4. Iraq's procurement through governmental and private trading companies from 1999 to 2002 39

5. Production of lethal chemical weapons agents, as declared by Iraq 43

6. Weaponization of lethal chemical weapons agents, as declared by Iraq 44

Abbreviations

BOMVIC	Baghdad Ongoing Monitoring, Verification and Inspection Centre
BMVC	Baghdad Monitoring and Verification Centre
GPS	Global Positioning System
IAEA	International Atomic Energy Agency
IAU	Information Assessment Unit
ISG	Iraq Survey Group
MIC	Military Industrialization Commission
MIMI	Ministry of Industry and Military Industrialization
MTCR	Missile Technology Control Regime
OMV Plan	Plan for Ongoing Monitoring and Verification
RPV	remotely piloted vehicle
SEPP	State Establishment for Pesticide Production
SOTI	State Organization for Technical Industries
TRC	Technical Research Centre
UAV	unmanned aerial vehicle
WHO	World Health Organization
UNMOVIC	United Nations Monitoring, Verification and Inspection Commission
UNSCOM	United Nations Special Commission
WMD	weapons of mass destruction

I. Building a United Nations verification regime

A. Forming the United Nations Special Commission in 1991

1. The United Nations Special Commission (UNSCOM) was created by the Secretary-General, in consultation with members of the Security Council, pursuant to Council resolution 687 (1991) of 3 April 1991. The resolution called for the establishment of UNSCOM as a subsidiary body of the Council to carry out, inter alia, immediate on-site inspection of Iraq's proscribed biological, chemical and missile capabilities and to oversee their destruction. The Director General of the International Atomic Energy Agency (IAEA) was tasked to conduct nuclear inspections with the assistance and cooperation of UNSCOM.

2. It was an unprecedented and challenging task since no international verification regimes comprising on-site inspections existed in 1991 in the areas of the UNSCOM mandate. The Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction (Biological Weapons Convention), which entered into force in 1975, does not provide for any system of inspection or verification. The text of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (Chemical Weapons Convention) was, in the early 1990s, under negotiation at the Conference on Disarmament in Geneva, and even now, no international verification system exists in the missile area.

3. Thus, the mission given to UNSCOM by the Security Council included not only the organizational task of establishing a verification body in the chemical, biological and missile areas, but also the development of an inspection system capable of verifying Iraq's compliance with its obligations, as mandated by the Council. While there were no developed procedures for the conduct of international inspections in these areas, recourse was made to the limited but evolving experience in disarmament and arms control verification that existed at the national and international levels, such as the following:

(a) Fact-finding missions initiated by the Secretary-General during the period 1984 to 1988 pursuant to the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare (1925 Geneva Protocol) to investigate the alleged use of chemical weapons in the Iran-Iraq war;

(b) On-site inspections under safeguards agreements pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons conducted by IAEA in various countries, including Iraq. Although these were not disarmament verification inspections, the inspectors accumulated significant experience of on-site activities that led to the development of many inspection procedures;

(c) Agreements in the areas of chemical, biological and nuclear weapons and missiles related to confidence-building, information exchange and arms reduction, and comprising on-site visits and inspections. These resulted in the development of national procedures for inspections and visits to various types of facilities;

(d) Mock challenge inspections and other inspection exercises conducted by some Governments in preparation for the conclusion of the negotiations on a chemical weapons convention.

4. The new organization was developed on the basis of what could be learned from the sources mentioned above and on what new capabilities would be necessary to meet the specific requirements of Security Council resolution 687 (1991), in which the Council had defined prohibited items as not only chemical and biological weapons in a limited sense, but also all related subsystems and components, stocks of agents, and all research, development, support and manufacturing facilities. As regards prohibited missiles, the definition covered all ballistic missiles over 150 km range and all related major parts, as well as repair and production facilities. The inspection authority provided to UNSCOM was unprecedented as it came to address not only declared but also undeclared capabilities and locations in the field of biological and chemical weapons and missiles. Furthermore, UNSCOM had the right to designate additional locations for inspection by IAEA (other than those declared by Iraq).

5. The first cell of UNSCOM, consisting of a few staff from the United Nations Secretariat (mainly from the Department for Disarmament Affairs), was set up in April 1991, immediately after the adoption of Council resolution 687 (1991), to assist in the formation of the Special Commission. By May 1991, the Secretary-General, in consultation with Council members, had appointed the Executive Chairman, his Deputy and 19 other Commissioners. The Commissioners included diplomats and experts in the areas of arms control, disarmament and non-proliferation, some of whom participated in inspections.

6. One of the first tasks of UNSCOM was to draft the text of an exchange of letters between the United Nations and the Government of Iraq on facilities, privileges and immunities to be enjoyed by the inspectors while in Iraq on official duties. The exchange of letters was agreed between the United Nations and the Government of Iraq on 14 May 1991 and was finalized on 18 May. It provided extensive rights for no-notice inspections related to declared and undeclared facilities. The exchange of letters provided, inter alia, for unrestricted freedom of movement of inspectors, equipment and means of transport into, out of and within Iraq for the access of inspectors to any location in Iraq; and for their right to receive, examine and copy records and to photograph any item. Furthermore, the rights of inspectors included the right to conduct interviews; the right to choose sites for storage and the construction and destruction of facilities for those purposes; the right to take aerial photographs; the right to take and analyse samples of any kind and to remove and export them for analysis; and the right to unrestricted communications by radio, satellite and other means. The exchange of letters obliged Iraq to facilitate the execution of these rights and to ensure the safety and security of all personnel involved in United Nations inspection activities.

7. On 17 May 1991, following consultation among the Executive Chairman of UNSCOM, the Director General of IAEA and the Director-General of the World Health Organization (WHO) and with appropriate Governments, the Secretary-General submitted to the Security Council a plan for the implementation of the disarmament provisions of resolution 687 (1991). The plan (S/22614 of 17 May 1991) included a three-stage approach: collection and assessment of information,

disposal of weapons, components and facilities; and monitoring and verification of future compliance by Iraq with its obligations.

8. In order to proceed rapidly with inspections, UNSCOM sited its executive office at the United Nations Secretariat in New York. The office consisted of an operational unit, a small administrative branch and a few assistants to the Executive Chairman. The members of the Special Commission, together with the staff of its executive office, reviewed Iraq's initial declarations, which it was required to submit within 15 days of the adoption of resolution 687 (1991). They also prepared operational plans to conduct a series of initial missions in Iraq. UNSCOM dispatched its first inspection team (related to chemical weapons) in June 1991. IAEA had conducted its first nuclear inspection in May 1991 with the support of the Special Commission.

9. After having investigated various options, in the summer of 1991, UNSCOM established a field office in Bahrain for the assembly, training, briefing and debriefing of inspection teams and for administrative and logistical support. The office was provided with secure facilities and two aircraft for the transport of inspectors, personnel, equipment and provisions in and out of Iraq. When the UNSCOM monitoring centre was established in Baghdad, the role of the regional Bahrain field office evolved and it then provided the monitoring centre with support for construction, refurbishment and supplies. The task of the Baghdad office encompassed special support to the chemical destruction programme, including the construction of chemical warfare destruction facilities during the period 1992-1994. With the subsequent implementation of the UNSCOM/IAEA monitoring and verification plans, the office became a centre of support for monitoring operations, including the continuous land-based camera surveillance of Iraqi weapons-potential production and storage facilities.

B. Support from Member States

10. During the initial phase, various United Nations departments, units and regional offices provided assets, expertise and support for UNSCOM activities. These included personnel, logistics, liaison with national Governments and other international organizations, as well as sharing the experience of United Nations missions and peacekeeping operations. However, the magnitude of the task given to UNSCOM by the Security Council went far beyond the capabilities available at that time within the United Nations. It required specific expertise in the areas of chemical and biological weapons and ballistic missiles, related verification technology and equipment and extensive mission support, including specialized medical treatment, explosive ordnance disposal capabilities, field communications and means of transportation. In addition, UNSCOM needed other assets required for credible verification, such as aerial surveillance, including satellite imagery, and laboratory capabilities that could be provided only by a limited number of Member States.

11. The Security Council, in its resolution 699 (1991) of 17 June 1991, decided that Iraq should be liable for the full costs of carrying out the tasks called for under section C of resolution 687 (1991). It also decided to encourage the maximum assistance, in cash and in kind, from all Member States to ensure that verification and disarmament activities under resolution 687 (1991) could be undertaken

effectively and expeditiously. UNSCOM requested a number of States to make available to it the services of qualified operational officers, experts and specialists to conduct inspections and provide technical support. These inspectors were recruited by UNSCOM primarily from among national expert advisers to the delegations participating in the negotiations within the Conference on Disarmament in Geneva and from leading national laboratories. UNSCOM also asked several countries to provide information support on substantive issues covered by its mandate. The assistance requested was provided by Member States, in most cases on a no-cost basis.

12. The Security Council did not refer the financing of UNSCOM and IAEA activities in Iraq to the General Assembly and its organs. Instead it decided that the activities would be financed by revenue from the sale of Iraqi oil. In the absence of such financing, Iraqi assets, frozen in various international banks and finance institutions, were drawn upon for the early needs of UNSCOM/IAEA. The resources made available under this procedure proved insufficient to cover all the costs. Therefore, current expenses had to be met from voluntary contributions by Governments. The matter of financing became a question of great concern, as the problem was exacerbated by the fact that UNSCOM, in accordance with resolution 687 (1991), also provided support to IAEA operations under the Security Council's resolutions. UNSCOM was forced to devote considerable efforts to raising funds in kind and in cash from supporting Governments. On 14 April 1995, the Security Council adopted resolution 986 (1995) permitting Iraq to export limited amounts of oil under United Nations control to pay for the import of foodstuffs and medicine. The resolution, inter alia, set aside some of the proceeds from the oil sales, later determined to be 0.8 per cent, to fund the activities of UNSCOM and IAEA in Iraq. Following Iraq's acceptance of the resolution in mid-1996, the financial status of the Commission was put on a firmer footing. Prior to the adoption of resolution 986 (1995), the following in-kind assistance was provided by Member States:

(a) **Expertise**. While the administrative staff consisted mainly of United Nations staff members drawn from the Secretariat, the operational officers, experts and specialists in the executive office and on inspection teams were recruited mainly from Governments under United Nations special service agreements whereby their salaries were covered by the Government while all other costs, such as travel and daily subsistence allowance, were funded by UNSCOM. This included different categories of inspection support staff, including medical officers, communications technicians, movement control officers, explosive ordnance disposal experts, photo-interpreters, linguists and information technology professionals;

(b) **Transportation**. Vehicles and fixed wing aircraft provided transport for inspection teams, together with equipment and supplies, to and from Iraq, and for emergency and medical evacuation of personnel from Iraq. A helicopter unit for the transportation of inspection teams within Iraq, aerial inspections and medical evacuation in emergency situations was also available;

(c) **Verification and inspection equipment**. A variety of equipment and materials, such as sampling and detection equipment, explosive ordnance disposal equipment and decontamination equipment were provided. To operate this equipment, it was usually deployed together with personnel of the contributing Member State;

(d) **Communications**. Secure means of communication were provided between the UNSCOM office in New York, its office in Baghdad, IAEA and national authorities of Member States that controlled the "no-fly zones" in Iraq. Communications equipment included field radio stations and mobile radios to provide communications within Iraq, between inspection teams and the UNSCOM office in Baghdad and between inspectors in the field. The services of technicians to operate this equipment were also provided by Member States;

(e) **Laboratory support**. National laboratories of Member States provided analysis of various samples of chemical and biological materials collected by the inspectors in Iraq. Different types of chemical and biological munitions and missile parts and components taken out of Iraq by inspectors for evaluation were examined by various national institutions of Member States;

(f) **Medical support**. Lifesaving equipment, medicines and other medical supplies were provided by Member States, together with the services of medical personnel, including physicians and paramedics. UNSCOM requested medical personnel to have specific experience in the treatment of possible casualties resulting from exposure to various types of unconventional weapons;

(g) **Information support**. Additional information from Member States on Iraq's chemical and biological weapons and ballistic missiles was provided. Member States also provided information on sites and locations in Iraq for inspection, including geographical coordinates, site diagrams and descriptions, and they arranged for relevant briefings to be given to inspection teams;

(h) **Aerial surveillance**. This included the conduct by Member States of frequent missions by high and medium altitude surveillance aircraft to provide overhead imagery of sites, locations and facilities for inspection, in accordance with the mandate of UNSCOM and on the basis of special arrangements with UNSCOM. They also provided the services of photo interpreters to evaluate the imagery collected. On a case-by-case basis, two Member States shared relevant satellite and aerial imagery with UNSCOM and IAEA; these were helpful in identifying movements of weapons components and undeclared destruction activities, especially those that were missile-related;

(i) **Information technology**. Member States provided computers, software, audio-, photo- and video-recording equipment and helped to establish secure computer networks in the UNSCOM offices in New York and in Baghdad;

(j) **Facilities**. A secure facility was established by some Member States in Bahrain to provide information to inspection teams going to Iraq. Member States also supported construction, refurbishment and security surveillance of the UNSCOM office in Baghdad and provided stand-by medical facilities in the region for medical evacuation and emergency medical treatment.

13. The early availability of assets and services enabled UNSCOM to commence rapidly its inspection activities in Iraq, support IAEA in its activities and establish its verification system during the period 1991-1998. By consolidating the best available expertise and technology provided by individual States, UNSCOM was also able to develop advanced verification methods, procedures and techniques that not only allowed it to verify Iraq's compliance, but also added to the experience of international verification.

C. Developing verification practices and procedures

1. Inspection procedures

14. Prior to the beginning of inspections in Iraq, UNSCOM had developed generic inspection plans. Detailed inspection procedures could not be developed in advance without knowing the specific situation in Iraq. The importance of the first inspections was that the inspection teams elaborated detailed operational procedures that were used as templates and were further extended by subsequent teams of inspectors.

15. The first series of inspections, carried out by UNSCOM in the summer of 1991, focused mainly on sites and locations where relevant weapons and materials had been declared by Iraq, in order to identify and to inventory them for destruction, removal or rendering harmless.

16. Special attention was paid to the safety of inspection operations, since the conditions of sites and facilities subject to inspections in post-war Iraq largely consisted of damaged structures, unexploded ordnance, chemical contamination and multiple other health hazards. Procedures were developed for the destruction, removal and rendering harmless of specific prohibited items and materials in Iraq.

17. Many procedures, modalities and guidelines were developed and applied by the United Nations during the period 1991-1998. Some of these were endorsed by the Security Council, such as procedures for inspections of presidential sites (February 1998), while others, such as the use of helicopters for aerial inspections, and health and safety guidelines were approved internally. In addition, numerous detailed internal guidelines were issued, such as those relating to the use of aircraft and means of communication. Guidelines on technical matters were issued by chief inspectors and senior officers, such as those for medical treatment and for chemical analyses at the Baghdad Monitoring and Verification Centre (BMVC) laboratory (later changed to the Baghdad Ongoing Monitoring, Verification and Inspection Centre (BOMVIC), while other procedures, mainly those related to the conduct of inspections, existed as common practices rather than formal guidelines.

18. Following Iraq's admission of concealment activities after the defection in 1995 of Lieutenant General Hussein Kamel (then the head of Iraq's Military Industrialization Commission (MIC)), additional emphasis was placed on investigation-type verification inspections, including interviews with Iraqi scientists and officials and document searches. Specific procedures were developed regarding the conduct of interviews and the forensic evaluation of documents and computers.

2. Staffing and organization

19. During the first months of 1991, UNSCOM headquarters had not more than a dozen executive officers, operational officers and experts. In 1992-1993, when it became clear that a long and complex verification programme was required to determine Iraq's compliance with the requirements of Security Council resolutions, UNSCOM was expanded to include four or five experts organized within weapons discipline groups: chemical, biological and missile. In addition, some nuclear experts were attached to UNSCOM to facilitate the planning of joint inspections with IAEA.

20. In autumn 1991, a special unit, the Information Assessment Unit, was set up, staffed with personnel trained in dealing with and protecting sensitive information provided by Member States. The Unit synthesized such information as well as open source material to produce assessments of Iraq's compliance with its obligations, and it identified sites and activities that required further investigation. As Iraq failed to give full accounting of its holding of prohibited items, the Unit's assessment and data collection capability became an essential source of information for UNSCOM. Over time, the information residing in the Unit came to be extensive and comprehensive.

21. UNSCOM personnel retained under United Nations special service agreements served as advisers to the Executive Chairman of UNSCOM and reported directly to him. The functions, positions and seniority within the various units and groups were defined generically.

22. There was a high degree of staff rotation in UNSCOM during the period 1991-1993 when the tour of duty of personnel whose services were provided directly by Member States ranged from a few months to a year. By 1993, however, it was recognized that longer periods were necessary, as solid institutional knowledge of Iraq's past proscribed programmes was a prerequisite for achieving and maintaining an efficient system of inspection and verification.

23. Following the adoption of Security Council resolution 1051 (1996) of 27 March 1996, a joint UNSCOM/IAEA unit was established in the office of UNSCOM for the implementation of the export/import monitoring mechanism for dual-use items and materials being delivered to Iraq.

24. In 1998, the UNSCOM office had a total staff of over 60 personnel, including some 20 staff members under various types of United Nations contracts and over 40 experts and specialists whose services had been made available by Member States. Owing to the mixed composition of its staff, UNSCOM had to develop a flexible organizational structure for its office. Personnel operated under direct guidelines from the Executive Chairman. This system enabled rapid adjustments in the face of changing operational requirements and circumstances. It was, however, sometimes difficult to demonstrate objectively that personnel whose services were made available were fully accountable for their activities only to the Commission.

3. Non-resident inspectors

25. Experts, specialists and technicians assigned by UNSCOM to participate in specific inspections were assembled in Bahrain before deployment to Iraq. All inspectors were retained under special service agreements and enjoyed the privileges and immunities commensurate with experts on mission for the United Nations. Chief inspectors were appointed by the Executive Chairman. In Bahrain, the inspectors were briefed by UNSCOM and by representatives of some Member States with regard to specific information, inspection tasks and requirements. A short period of pre-inspection training, normally from a few days to a week depending on the nature of the inspection, was also organized in Bahrain.

26. UNSCOM sought to maintain the participation of the most skilled inspectors in multiple sequential inspections in Iraq. Although this was an important factor in developing institutional knowledge and in follow-up action with successive inspections, it was not always possible. This depended on the availability of the

individual inspectors and the readiness of their respective national authorities to make their services available to the United Nations. Thus, most of the inspectors involved in UNSCOM operations in Iraq participated in only one or two inspections, while a core group of inspectors were involved in multiple inspections.

27. With respect to BMVC, its organizational structure was more formal and addressed multiple issues relevant to its functions, including chain of command and coordination between various resident inspection teams and support units. In 1998, BMVC was staffed with up to 100 personnel, including members of resident monitoring teams and operational, support and administrative staff. While its Director and administrative personnel were United Nations staff members, most of its inspectors, operational and support staff had been made available by Member States as consultants under United Nations special service agreements.

4. Inspection activities

28. Within the field of verification of disarmament, the United Nations conducted a variety of inspections in Iraq. These included the initial evaluation of declared facilities, items and materials, follow-up inspections of declared facilities and sites designated by UNSCOM, and the supervision of the destruction, removal and rendering harmless of weapons, designated facilities, items and materials. In addition, there were search inspections, interviews, technical seminars and technical evaluation meetings with Iraqi officials and scientists.

29. Facilities and sites inspected included industrial facilities, research centres, military installations and ammunition depots, offices of ministries, agencies and companies, public health facilities, transportation companies, customs offices and trading companies, as well as geographic locations covering large areas. Depending on the specific verification objectives, most facilities and sites were identified to the Iraqi counterparts only upon the arrival of inspection teams at their respective locations and were inspected without any advance notice. Some other facilities, where advance coordination was required for purposes such as the installation of cameras and sensors, were inspected with short advance notice, while sites where extensive technical input was required from Iraq, such as equipment and personnel for the destruction or excavation of proscribed items, were also identified in advance to the Iraqi authorities.

30. Activities carried out at inspection sites varied, and included site exploitation, evaluation and accounting for relevant equipment, items and materials, securing sites to prevent removal of relevant items and materials, sampling, discussions, interviews, document searches and forensic computer evaluations. Samples taken in the course of inspections were sent for analysis to various national laboratories of Member States. In most cases, UNSCOM did not retain samples for reference purposes. In some cases, samples were analysed by only one national laboratory. The samples taken were not shared with Iraq, which disputed several of the analytical results reported to UNSCOM by national laboratories.

31. In late 1993, after Iraq accepted the plan for ongoing monitoring and verification (OMV Plan) approved by the Security Council in resolution 715 (1991) of 11 October 1991, additional types of inspections were conducted. These included baseline inspections aimed at the identification of dual-use facilities, items and materials in Iraq, the verification of Iraq's declarations under the OMV Plan, and technical missions relating to the installation of monitoring equipment, cameras and

other sensors. Resident inspection teams conducted monitoring inspections that included aerial inspections, environmental monitoring and the maintenance of verification equipment. The UNSCOM chemical laboratory established at BMVC could conduct analysis of air, soil and other environmental samples and the biological room was capable of preparing biological samples for outside analysis. In 1996, an export/import monitoring team joined other resident inspection teams at BMVC and conducted various inspections at points of entry to Iraq, customs offices, trading companies and distribution facilities. They also verified the end-use in Iraq of items subject to notifications under the mechanism. In 1998, a multidisciplinary resident team was established at BMVC to inspect sites and locations that might contain undeclared items or related activities.

32. UNSCOM conducted inspections relating to the verification of disarmament mainly through the deployment of non-resident inspection teams to Iraq, while resident teams at BMVC were involved mainly in monitoring activities within the scope of the OMV Plan. Although resident teams and other units at BMVC were sometimes tasked by headquarters, on a case-by-case basis, to verify specific issues of proscribed programmes and to provide technical support to non-resident inspection teams, the verification of disarmament was generally kept separate from monitoring inspections.

33. UNSCOM realized at an early stage the advantages of a multidisciplinary approach to the verification process, and it conducted several multidisciplinary inspections in Iraq with non-resident and resident inspection teams. Joint chemical, biological, missile and export/import inspections were also conducted. Inspection teams that included a multidisciplinary mix of expertise enhanced the team's ability to recognize and assess properly the relevance of dual-use equipment and capabilities in the chemical, biological and missile fields. A number of inspections were conducted jointly with IAEA.

34. A balance was maintained between the need for operational security and the efficient preparation of inspections. These security precautions were deemed sensible since Iraq was presumed to be collecting information on UNSCOM inspection plans, and it was necessary to protect the integrity of the inspection process as much as possible. UNSCOM archives and databases were compartmentalized between and sometimes within operational disciplines. Only some senior staff and experts from the UNSCOM office were authorized by the Executive Chairman to interact with relevant national authorities of Member States to receive additional information on issues relevant to the Commission's mandate.

D. Establishment of the United Nations Monitoring, Verification and Inspection Commission in 1999

35. As was recommended by the panel concerning disarmament and current and future ongoing monitoring and verification issues, established pursuant to the note by the President of the Security Council of 30 January 1999, known as the Amorim panel, various lessons learned from the experience of UNSCOM were taken into account in the drafting of Security Council resolution 1284 (1999) of 17 December 1999. The resolution established the United Nations Monitoring, Verification and Inspection Commission (UNMOVIC) as a subsidiary organ of the Security Council to replace UNSCOM to undertake the responsibilities mandated to UNSCOM in the

verification of Iraq's compliance and to take over UNSCOM assets, liabilities and archives. UNMOVIC was also to assume the Special Commission's part in agreements existing between the Special Commission and Iraq and between the United Nations and Iraq. Moreover, UNMOVIC was tasked by the Security Council to establish and operate a reinforced system of ongoing monitoring and verification to implement the plan approved by the Council in its resolution 715 (1991).

36. The Executive Chairman of UNMOVIC was assisted in his tasks by the creation of the College of Commissioners, an advisory body consisting of 16 commissioners. The College operated as a body and scheduled its meetings to discuss UNMOVIC work, assessments and the results of inspections and, as required by Council resolution 1284 (1999), it provided input into and comments on the Executive Chairman's quarterly report to the Security Council and discussed policy issues raised by the Executive Chairman.

37. The organizational plan for UNMOVIC, prepared by the Executive Chairman in consultation with the Secretary-General and approved by the Security Council, incorporated the following specific provisions drawn from practical lessons learned by UNSCOM and IAEA:

(a) Although different parts of the organization should complement and cooperate closely with each other, the functions of operations should be kept deliberately separate from analysis within the organizational structure of UNMOVIC. While UNSCOM core staff had been responsible for both verification activities and assessment of their results, UNMOVIC established two separate units for those purposes, the Division of Planning and Operations and the Division of Analysis and Assessment. The Division of Planning and Operations was responsible for planning, directing and performing all monitoring, verification and inspection activities. The Division of Analysis and Assessment was responsible for the analysis and assessment of information resulting from the organization's own activities in the field and data from other sources, such as information on export/import activities, overhead imagery and outside information. BOMVIC was directly subordinate to the Director of Planning and Operations;

(b) UNMOVIC expanded upon the UNSCOM experience of multidisciplinary verification and established dedicated multidisciplinary sections in the Division of Analysis and Assessment and in the Division of Planning and Operations that included multidisciplinary inspection teams in Iraq;

(c) From the beginning, UNMOVIC established an office for outside information sources that, apart from the Executive Chairman, was the sole entrance point for intelligence provided by Governments. It was recognized that although dialogue with providers might be necessary in order to seek clarification and to indicate what might be of particular interest to the organization in discharging its tasks, the flow of intelligence had to be one-way only to UNMOVIC and have regard only to matters relevant to the mandate of UNMOVIC;

(d) The system of cooperative management established by UNMOVIC ensured unity of purpose, mutual assistance and the sharing of as much information as possible. At the same time, it encompassed the need for strict confidentiality of information regarding sites, objectives and the timing of inspections and about data underlying the inspections, which was shared strictly on a "need-to-know" basis;

(e) While UNSCOM databases and archives had been compartmentalized and maintained by individual disciplines, UNMOVIC formed a Data-Processing and Archives Unit to establish, operate and maintain a central, integrated database. This included the organization's archives, consisting of information from a variety of sources, such as data taken over from UNSCOM and the results of UNMOVIC inspection and monitoring activities. These were also accessible on a "need-to-know" basis;

(f) UNMOVIC established an imagery evaluation unit, similar to that of UNSCOM, that not only processed the specialized non-commercial imagery provided by Governments, but also acquired and processed commercial overhead imagery to support the activities of the Division of Planning and Operations and the Division of Analysis and Assessment. In a manner similar to that of UNSCOM, Member States supported the Commission through the provision of high-altitude and medium-altitude surveillance aircraft at no cost to the United Nations. In addition, one of the helicopters contracted by UNMOVIC was equipped for the acquisition of aerial imagery during day and night and was used for surveillance;

(g) While UNSCOM had used verification technology, equipment, transportation, logistics and mission support provided mainly directly by Member States, UNMOVIC acquired most of these assets and services through the established United Nations procurement procedures. This enabled the acquisition of the most advanced technology, development of coherent and unified verification procedures and provision of a high degree of operational readiness in the planning and conduct of inspections. At the same time, a limited number of unique instruments and materials, such as ground penetrating radar technology and life-saving equipment, were also provided by Member States, as had been the case with UNSCOM;

(h) The acquisition by UNMOVIC of its own verification technology and equipment allowed it to train its inspectors in advance on the use of specific instruments and items of equipment;

(i) In contrast with the staff of UNSCOM, the vast majority of UNMOVIC staff were recruited as United Nations staff members. To supplement staff on inspection teams, UNMOVIC established a roster of trained inspectors from more than 50 countries. When called upon to serve as inspectors in Iraq, members of the roster were recruited as United Nations staff members under short-term contracts. Under both types of contracts, staff members were subject, in particular, to Articles 100 and 101 of the Charter of the United Nations concerning their status as international civil servants responsible only to the Organization, meeting the highest standards of efficiency, competence and integrity and representing as wide a geographical base as possible. Only a very limited number of selected specialists whose services had been made available by Member States were engaged by UNMOVIC for its verification activities in Iraq, such as medical and communications personnel;

(j) UNSCOM inspectors had been trained mainly on-the-job. All those selected for employment or to be included on the roster were required to go through UNMOVIC training. The training included proscribed weapons and programmes, monitoring and verification methods and procedures, dual-use technology, sampling and analysis, health and safety and cultural training. The personnel had special skills

and expertise, not only on WMD but also in specific fields of technology relevant to Iraq's declarations.

38. An inspectors handbook was produced as a single source of guidance and regulations covering all aspects of UNMOVIC operations and activities. The handbook included operating procedures for inspections, aerial surveillance, transportation, accommodation, UNMOVIC rights and responsibilities, relations with the media, Iraq's disarmament obligations, discipline-specific procedures, sampling and analysis, and health and safety guidelines, as well as the texts of relevant governing resolutions and related legal instruments.

39. An administrative manual was issued to guide UNMOVIC personnel in the discharge of their responsibilities. It served as a compendium of administrative rules and procedures customized for UNMOVIC activities and requirements, consistent with and complementing those of the United Nations covering, inter alia, communications and records, personnel matters and management of confidential information.

40. After November 2002, with the resumption of monitoring and verification activities in Iraq, UNMOVIC was able to deploy rapidly a large number of inspection teams to Iraq, drawing on inspectors from its headquarters and the roster. As of the end of February 2003, UNMOVIC core staff in the Professional grades at UNMOVIC headquarters included 75 persons of 30 nationalities, while the number of UNMOVIC personnel in Iraq had reached a total of over 200 staff. As of March 2006, 381 persons had been trained, including 30 core Professional staff members that are currently working at headquarters. Over 300 (non-staff) members of the roster have confirmed their availability to serve on UNMOVIC missions.

E. Further development of the verification system

41. UNMOVIC developed further the previous multidisciplinary approach to inspection operations. Inspection teams, consisting of experts with different scientific backgrounds, were set up, which enabled the proper conduct of inspections at sites with multiple activities. As a result, a more complete understanding of the sites was developed since it was possible to obtain, in addition to information ascertained under a specific weapons discipline, complementary information about procurement, contracts and relationships with other companies and national and foreign suppliers.

42. An additional regional office established by UNMOVIC in the north of Iraq, in Mosul, and operated by a multidisciplinary team of inspectors provided several advantages. These included a greater number of and more efficient inspections owing to the relatively short travel distances to a significant number of sites in northern Iraq and the increased effectiveness of verification through the attainment of faster unannounced access to sites. A planned regional office in the south of Iraq, in Basra, had not materialized before United Nations inspectors were withdrawn from Iraq in March 2003.

43. UNMOVIC established its own analytical chemical laboratory at BOMVIC, expanding the UNSCOM facilities there. In addition, it also established a biological laboratory at BOMVIC for the screening of biological samples taken in the course of inspections.

44. A network of laboratories was established comprising 11 internationally recognized laboratories in various parts of the world. They were contracted to perform analysis of samples provided by UNMOVIC in accordance with strict procedures.

45. In contrast with the UNSCOM experience, the following procedures for the analysis of samples to be performed outside of Iraq were introduced and followed by UNMOVIC:

(a) Chain-of-custody procedures were established to ensure the integrity of samples throughout the process of sampling, transport and analysis;

(b) One portion of each sample was to be given to Iraq and another retained by UNMOVIC as a reference;

(c) Samples were to be independently analysed by at least two laboratories in the network;

(d) All samples, as well as raw data and analytical results generated in the course of analyses by the outside laboratories, remained at all times the property of UNMOVIC and were to be kept confidential by the laboratories;

(e) UNMOVIC was solely responsible for drawing any conclusions and assessments from the analytical results.

46. UNMOVIC experience in both planning and operations and in analysis and assessment shows that there are still some areas where further improvement can be made. These include the following:

(a) Synchronization of formats of declarations and lists of relevant dual-use items and materials to be declared by Iraq under the auspices of the OMV Plan and the export/import monitoring mechanism to ensure coherence between those declarations and to avoid ambiguities during inspections;

(b) Optimization of formats of inspection reports to ensure that relevant data would be reflected expeditiously in the central integrated database and could be promptly made available for the assessment of inspection results and planning for follow-up inspections;

(c) Augmentation of specific weaponry-related expertise both of the UNMOVIC staff and with respect to training programmes for inspectors to ensure that remnants and components of old proscribed weapons are more easily identifiable from the myriad of conventional arms remaining in Iraq.

F. Major achievements

47. From its inception, UNSCOM had achieved remarkable success. Within two months of its establishment the first inspection team was in Iraq, an inspection regime had been set up and various inspection procedures were in place. As inspectors had little prior training as international inspectors and almost no familiarity with working together, much was learned on the job. By the time of its replacement by UNMOVIC, late in 1999, thousands of chemical weapons and hundreds of tons of bulk warfare agents had been destroyed under its supervision, missiles and related facilities had been rendered harmless or destroyed and abundant evidence for illicit biological activities had been uncovered to place sufficient

pressure on Iraq for it to acknowledge that it had had an offensive biological weapons programme. In addition, in 1996, following the adoption of Security Council resolution 1051 (1996) which enabled the monitoring of imported dual-use items and materials, UNSCOM had introduced an export/import monitoring mechanism. Despite Iraqi efforts at concealment and denial, UNSCOM had been able to develop a reasonably comprehensive understanding of the totality of Iraq's WMD programmes, although many issues remained unresolved.

48. The United Nations verification system constantly evolved and developed with experience and through ongoing training. From 1991 to 1993, at the beginning of the process of international verification in Iraq, the inspectors relied largely on information provided by Member States regarding suspected sites and locations in trying to establish the organizational structure of proscribed programmes. By 1994-1995, however, they had developed a broad institutional knowledge of the scope of Iraq's programmes and had refined their verification capabilities.

49. The international verification system developed by UNSCOM was further expanded and transformed by UNMOVIC into a reinforced system of ongoing monitoring and verification in line with the requirements of the Security Council.

50. It was possible to develop a comprehensive monitoring and verification system in Iraq that covered multiple areas of WMD and delivery means. Despite the remaining unresolved issues (such as total quantities of biological agents produced), owing mainly to Iraq's past concealment efforts and unilateral destruction of WMD and related materials, the system of international verification was able to make significant progress in the identification and mapping out of Iraq's past proscribed weapons programmes. This demonstrates that even concealed and heavily guarded proscribed programmes or their elements cannot be hidden in their entirety from an effective and comprehensive system of United Nations inspection and verification.

51. The United Nations verification system was also able to deter the resumption of proscribed activities by Iraq after 1991. During the period 1992-1993, Iraq attempted to conceal some ongoing proscribed missile projects. These projects were halted once the monitoring system under the OMV Plan was established and became fully operational. Only during the period from 1999 to 2002, when United Nations inspectors were absent from Iraq, did Iraq engage in proscribed missile activities.

52. With respect to specific verification methods and procedures, UNSCOM had introduced a system of inspection whereby monitoring teams that were resident in-country were integrated with aerial inspections using helicopters and were thus able to undertake combined ground and aerial inspections. It had also made innovations in developing techniques for on-site no-notice inspections, document exploitation and interviews. UNMOVIC developed the experience of UNSCOM and, in some areas, acquired more resources and advanced specialized tools.

53. The United Nations verification experience in Iraq illustrates that in-country verification, especially on-site inspections, generates timely and accurate information. The experience also demonstrates that an effective and comprehensive verification system is based on two major elements: institutional knowledge encompassing the detailed experience and expertise gained from inspections and technical capabilities comprising verification technology and other necessary specialized assets. Clearly, both cannot be acquired instantly. This takes a significant amount of time, effort, resources and budgetary allocations.

II. Organizational structure of Iraq's proscribed weapons programmes

A. Scope of proscribed weapons programmes

54. Security Council resolution 687 (1991) of 3 April 1991, required Iraq to declare to the Secretary-General, within 15 days of its adoption, the locations, amounts and types of all chemical, biological and nuclear weapons and ballistic missiles with a range greater than 150 km, as well as related subsystems, components and associated facilities. The resolution called for these items to be destroyed, removed or rendered harmless by Iraq under international supervision.

55. Had Iraq complied with the Security Council's requirements and provided the information required in a coherent and complete fashion to the United Nations, the entire process of verification could have been completed without delay. Instead, the verification process was drawn out over 13 years from 1991 to 2003, which included extended periods of total non-cooperation by Iraq such as in 1997 and 1998.

56. Iraq submitted its first declarations under Security Council resolution 687 (1991), to the United Nations in April and May 1991 and, thereafter, IAEA and UNSCOM commenced inspections to verify these declarations. The initial inspections revealed that the declarations were incomplete and that Iraq had not declared relevant items, materials and information. This led the Security Council to adopt resolution 707 (1991) of 15 August 1991, demanding that Iraq provide full, final and complete disclosure of all aspects of its programmes to develop WMD and ballistic missiles. The resolution also demanded that Iraq allow UNSCOM and IAEA inspection teams immediate, unconditional and unrestricted access to any and all areas, facilities, equipment, records and means of transportation that they wished to inspect.

57. Iraq did not accept resolution 707 (1991) until 1992. Over the period 1992 to 2002, Iraq submitted several sets of chemical, biological, missile and nuclear declarations, each set either adding to or rearranging information provided in the previous set. In its initial declarations, Iraq sought to minimize the extent of its proscribed programmes and to obscure information concerning their affiliation with ministries, agencies and facilities in Iraq. It would appear that the following factors contributed to Iraq's decision not to reveal such information to the United Nations:

(a) Preservation of valuable resources by minimizing the extent of destruction, removal and rendering harmless of items, materials and facilities involved in proscribed programmes (particularly while it remained under comprehensive United Nations sanctions);

(b) Preservation of the ability to conduct clandestine work on some proscribed missile projects and, possibly, intent to resume other proscribed programmes after the departure of the United Nations inspectors from Iraq;

(c) National security concerns led Iraq to prevent inspection teams from entering sensitive areas of governmental infrastructure, such as institutions of political leadership, military command and control facilities, special security apparatus and intelligence;

(d) Protection of the identity of senior members of the former regime who were involved in the decision-making process, supervision, control and implementation of proscribed weapons programmes;

(e) Safeguarding information relating to rationale and military doctrines for the deployment of proscribed weapons, including possible targets and chain of command, as well as political sensitivity concerning any evidence of the past use of chemical weapons by Iraq;

(f) Protection of information on the procurement network and foreign contacts in support of proscribed weapons programmes in order to shield providers of technology, items and materials, and also on what was specifically acquired by Iraq for these programmes;

(g) Concerns that other States could attempt to collect intelligence information on Iraq within the framework of United Nations inspections.

58. It is not clear which of these factors dominated Iraq's concealment policies. However, all of these, separately or in combination, predetermined the extent of Iraq's declarations prior to 1995. Even later, after the defection of Lieutenant-General Hussein Kamel from Iraq in 1995, Iraq continued to limit the information it provided on the organizational structure of the programmes, addressing only specific questions from the United Nations inspectors on a case-by-case basis and rarely volunteering information.

B. Mapping the organizational structure

59. When UNSCOM began its verification activities in Iraq, it had little information or understanding of the true scope of the proscribed programmes.

60. The inspectors realized that knowledge of the organizational structure of Iraq's proscribed weapons programmes was instrumental to the verification of all aspects of those programmes. Early information on the organizational structure of the programmes would have enabled the inspectors to identify clearly the scope of the programmes, their affiliation and chain of command, and through this, to define what specific facilities, items and materials were relevant to WMD. In the face of Iraq's reluctance to disclose this information, the inspectors used a variety of verification techniques and tools to obtain as much data as possible.

1. Interviews and discussions

61. Interactions with Iraqi officials, scientists and technicians provided another opportunity to obtain additional information on the organization and scope of the programmes to compensate for the lack of documentation. Important issues revealed during interviews and discussions included the chain of reporting, directives and guidelines received by the personnel of the programmes, links to other establishments and names of those involved.

62. Despite Iraq's efforts to control the interviewing process by coaching potential interviewees in advance of anticipated requests for interviews, inspectors were still able to glean important information. Contradictions and inconsistencies between individual statements, which inevitably occurred, exposed gaps in their cover stories. These subsequently provided inspectors with indications of the directions in

which additional inspections or interviews might be warranted. In order to corroborate testimonies and statements on specific issues, all categories of staff, including managers, engineers, technicians, security personnel and support staff were interviewed.

2. Document search and exploitation

63. Documents and records generated in the course of planning and implementation of proscribed weapons programmes have proven to be one of the most reliable sources of information. As the inspectors soon learned, however, by the time inspections had started in 1991, almost all relevant documents had been removed from the sites and locations Iraq had declared to have been involved in proscribed weapons programmes. It was only in 1995, following the defection of Lieutenant-General Hussein Kamel and the revelation of the "chicken farm" (Haidar Farm) documents, that Iraq revealed a significant portion of its remaining archives of relevant documents, records and other materials that it had concealed from the inspectors. Prior to 1995, the inspectors were able to collect bits and pieces of information, mainly in the course of inspections of undeclared sites, that shaped their understanding of the organizational structure. For example:

(a) In 1991, an IAEA inspection team discovered files containing nuclear-related documents. In 1992, an UNSCOM inspection team, while inspecting a construction company of MIC found a diagram on the wall in the office of the Director-General showing all projects that had been accomplished, including a number of facilities involved in nuclear, chemical, biological and missile programmes;

(b) Even basic documents containing general information can be useful. In 1995, inspectors found a telephone directory of the headquarters of MIC. This proved to be very useful in mapping the organizational structure of Iraq's military industries, the affiliation of different establishments and associated chains of command.

3. Forensic computer exploitation

64. Forensic exploitation of computers and electronic media has also proven to be an effective tool in obtaining additional information not declared by Iraq. In 1998, a dedicated group of computer forensic experts attached to inspection teams used special equipment and techniques to search computer hard drives, floppy disks and tapes for keywords and topics of interest. Early in 2003, a forensic computer search by the joint IAEA/UNMOVIC inspection team during the inspection of a facility in Iraq resulted in the discovery of important procurement files. These files contained information on trading companies established by MIC and a network of foreign suppliers. This network was used by Iraq for the acquisition of foreign missile parts and components.

4. Contacts with former suppliers

65. Interactions with former foreign suppliers of items and materials used by Iraq for proscribed weapons programmes helped to identify Iraqi organizations and individuals involved in procurement activities and negotiations. It was found that a variety of Iraqi agencies and organizations had provided material support to those programmes.

5. Evaluation of bank accounts

66. The evaluation of data concerning bank accounts, financial transactions and invoices of the facilities involved in proscribed weapons programmes obtained through inspection activities and from Iraq, its suppliers and other sources, helped to identify the network of facilities and organizations of Iraq's military industries that were linked to those programmes.

C. Iraq's military industries and proscribed programmes

67. Iraq's proscribed weapons programmes were integral parts of its military industries. During the period from 1968 to 1991, Iraq built a command-style economy suitable for military purposes. A major part of the economy was linked both directly and indirectly to the military and, in many cases, to weapons activity. A brief overview of the history of Iraq's military industries is required to understand their role, functioning and chain of command.

68. In 1972, after the Government nationalized the oil sector of the economy and major industries in Iraq owned by foreign companies, oil revenues and assets required for modernization became available. One element of government doctrine was to modernize and improve the technological base of the Iraqi economy to minimize its dependence on foreign countries. This plan included the construction of new modern enterprises using foreign know-how and contractors funded largely by oil sales. The technical modernization of Iraq's armed forces was an integral part of this plan. The newly established State planning committee, chaired by the Vice-President of Iraq, coordinated and supervised all industrial developments, including the establishment of military industries.

1. Early days of military industrialization

69. To organize the construction of military industries, Iraq's Ministry of Industry created a military industrial committee, which functioned as a coordination and advisory board rather than an administrative cell. In the early 1970s, in coordination with the Ministry of Defence, the committee, as a matter of priority, developed new military-industrial complexes and expanded those that had been earlier established. This became the foundation upon which Iraq's military industrialization was built.

70. The development of the military-industrial complexes included two facilities for the production of small arms, the Yarmuk State Establishment in Abu Ghraib and the Qadissiyah State Establishment in Mahmudiyah. There was also a production complex for manufacture of explosives, propellants and their ingredients and raw materials in Latifiyah known as the Al Qa Qaa State Establishment, Iraq's largest military-industrial complex, which was instrumental in supporting Iraq's chemical, nuclear and missile programmes. Another facility for testing and production of artillery ammunition and associated components, later known as the Huteen State Establishment, was constructed at Iskandariyah. In order to expedite the establishment of military industries in Iraq, the Ministry of Industry created its own construction company, Al Saad, later known as the Al Fao State Establishment. The chemical weapons and biological weapons programmes at that stage were not part of this early military industrialization effort.

71. The first interest in chemical weapons was expressed by Iraq's Ministry of Defence in 1971, when a chemical laboratory complex was established to obtain practical experience in the synthesis of chemical warfare agents. In 1973, the Arab-Israel war sparked further interest in the acquisition of a chemical and biological warfare capability. In 1974, the Al-Hazen ibn al-Haitham Institute was created to conduct scientific, academic and applied research in the fields of chemistry, physics and micro-organisms. The new organization was attached to the Ministry of Higher Education and Scientific Research but was in reality affiliated to and run by the State intelligence and security apparatus. It was also supported by the Ministry of Industry with regard to the construction of its infrastructure and the acquisition of necessary technology, equipment and materials.

2. State Organization for Technical Industries

72. In 1974, a formal agency, the State Organization for Technical Industries (SOTI) was created to oversee and coordinate the development of Iraq's military industries and weapons programmes. It was run by a board of directors that included high-ranking representatives from the office of the Presidency, the Ministry of Defence and the Ministry of Industry. Its organizational structure reflected the major directions of its activities, including artillery production, aerial weapons and air defence.

73. Created in 1981 under the name of the State Establishment for Pesticide Production (SEPP), Iraq's chemical weapons programme, project 922, relied on SOTI for matters such as its budget, finance, procurement and construction. On operational issues relating to the types and quantities of chemical weapons, the programme was directed by the Ministry of Defence and the management reported directly to the Minister. After the Iran-Iraq war began in 1980, the chemical weapons programme became a top priority for SOTI. By a decision of the Revolutionary Command Council, SOTI was given an extraordinary degree of authority in implementing the programme.

74. SEPP was authorized to import and purchase all necessary materials, substances and equipment, to interact with governmental, local and foreign agencies and entities both inside and outside Iraq and to acquire commercial, industrial and technical assets from foreign companies. It was also authorized to own and possess funds and property, enter into contractual obligations either directly or on behalf of other agencies, build and rent stores, depots and other facilities, borrow funds for the implementation of its tasks, recruit and train a cadre of scientists and technicians, and maintain working contacts with foreign experts and scientists. In addition, it had its own financial and accounting system with financial and administrative autonomy to be controlled by its board of directors.

75. The Technical Research Centre (TRC) at Salman Pak was created in 1985 (replacing the previously created Scientific and Technical Research Centre) as a research and development branch of the intelligence and security apparatus. Although it cooperated with SOTI, TRC was technically outside its authority. TRC came under the direct personal supervision of Lieutenant-General Hussein Kamel.

76. SOTI was able to consolidate Iraq's industrial capabilities and to use them for various weapons programmes. It was transformed in 1987 into MIC, headed by Lieutenant-General Hussein Kamel.

3. Ministry of Industry and Military Industrialization

77. After the success of several projects carried out by SOTI and MIC that were critical for waging war with the Islamic Republic of Iran, in particular, the development of the chemical weapons programme and modification of the foreign Scud-B missile into the extended range Al Hussein missile capable of reaching Tehran, the role of military industrialization grew further. This resulted in the merging of MIC with the Ministry of Industry and the Ministry of Light Industries under the Ministry of Industry and Military Industrialization (MIMI) headed by Lieutenant-General Hussein Kamel. His close family connection to the President of Iraq also facilitated the decision to create a "super" ministry that would consolidate all industrial capabilities available in Iraq.

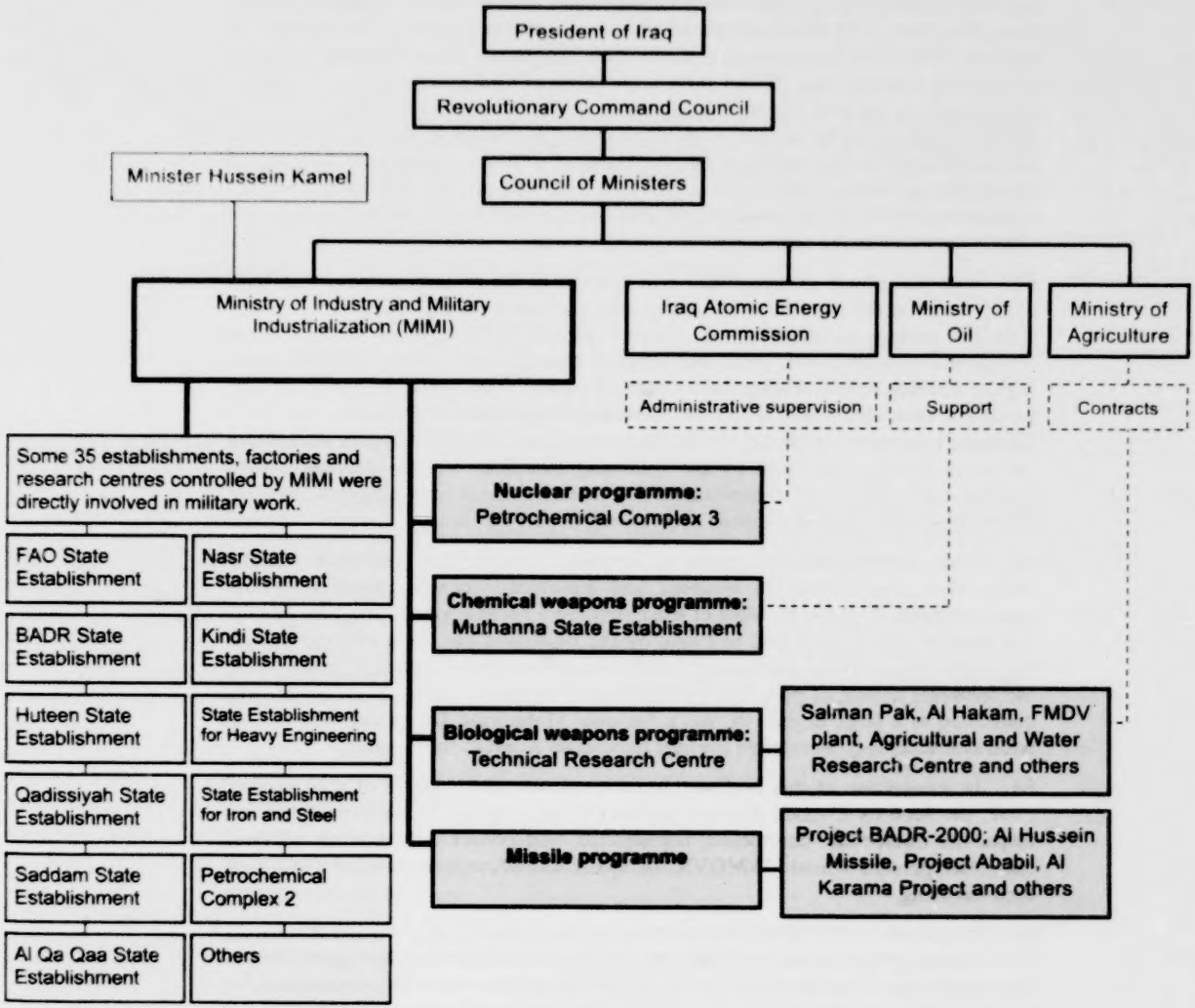
78. All weapons-related activities came under the authority of MIMI. In addition to the chemical weapons programme and missile projects, these included the weaponization part of Iraq's nuclear programme and the biological weapons programme run by TRC. The organizational structure of Iraq's military industries as of 1990 is provided in chart 1 below.

79. In 1990, MIMI supervised over 100 establishments, factories, plants and research centres in Iraq. Of these, some 35 facilities were known to have been directly involved in the research, development and production of various types of arms, including chemical and biological weapons and missile systems. The centralized management and structure of industries allowed Iraq to utilize all available industrial capabilities of other establishments in support of ongoing weapons development and production.

80. Shortly after the 1991 Gulf war, MIMI was dissolved. The Ministry of Industry and Minerals was created and MIC was re-established as a separate agency with the remains of other military-industrial establishments. A National Monitoring Directorate under MIC was created by Iraq to interact with United Nations inspectors.

Chart 1

Organizational structure of Iraq's military industries in 1990


President of Iraq
Revolutionary Command Council
Minister Hussein Kamel
Council of Ministers
Ministry of Industry and Military Industrialization (MIMI)
Iraq Atomic Energy Commission
Ministry of Oil
Ministry of Agriculture
Administrative supervision
Support
Contracts
Some 35 establishments, factories and research centres controlled by MIMI were directly involved in military work.
FAO State Establishment
Nasr State Establishment
BADR State Establishment
Kindi State Establishment
Huteen State Establishment
State Establishment for Heavy Engineering
Qadissiyah State Establishment
State Establishment for Iron and Steel
Saddam State Establishment
Petrochemical Complex 2
Al Qa Qaa State Establishment
Others
Nuclear programme: Petrochemical Complex 3
Chemical weapons programme: Muthanna State Establishment
Biological weapons programme: Technical Research Centre
Salman Pak, Al Hakam, FMDV plant, Agricultural and Water Research Centre and others
Missile programme
Project BADR-2000; Al Hussein Missile, Project Ababil, Al Karama Project and others

D. Military industries and human resources

81. The State-sponsored education and training of a national cadre of scientists, engineers and military officers was an integral part of the reforms introduced by the Iraqi Government in 1968. While in the late 1960s and early 1970s, a core of military officers who later became involved in and moved Iraq's chemical weapons programme forward were trained abroad, the scope of foreign training was expanded dramatically in the mid-1970s. The expansion occurred both in terms of educational profile involving advanced university degrees and doctorates in the areas of science and technology corresponding to developments of military industries in Iraq and in the number of foreign countries that provided such training. The Ministry of Higher Education and Scientific Research and Iraqi security and intelligence agencies were usually involved in the organization of foreign training.

82. With the growth in recognition and prestige of the military industries in Iraq, SOTI recruited the most talented young officers, engineers and scientists. A career with the military-industrialization complex provided solid social status, further educational opportunities, including studies abroad, and even exemption from regular military service during the Iran-Iraq war. The most dedicated young recruits formed a core of some 100 top executives of Iraqi military industries by 1991. Characteristic steps in the career development of one of the managers of military industries can be illustrated by the following example: military officer, foreign training, researcher, head of department in a research branch of intelligence, director of establishment, head of weapons programme, deputy minister.

83. Over 2,000 managers, scientists, engineers and technicians were directly involved in Iraq's chemical weapons and biological weapons programmes and proscribed missile projects. Most of these personnel became known from documents and records provided by Iraq or found by the inspectors and from interviews with the Iraqis. Access to all categories of staff was proven to be critical in establishing the technical details of proscribed programmes. However, access to personnel was controlled to a large degree by Iraq's National Monitoring Directorate and not all were available; they were often claimed to be dead or out of the country.

84. In recognition of this problem, in its resolution 1441 (2002) of 8 November 2002, the Security Council decided that Iraq should provide to the United Nations inspectors immediate, unimpeded, unrestricted, and private access to all officials and other persons whom UNMOVIC or IAEA wished to interview, at a place of their choosing.

85. In addition, in the 1980s several Iraqi military-industrialization establishments and weapons programmes, especially missile projects, contracted foreign experts as consultants and even hired foreigners. The level of access to foreign personnel by the inspectors was limited to the extent of cooperation and support provided by the relevant Member States.

E. Importance of investigation of the organizational structure

86. In 1991, when the inspectors began the verification of Iraq's declarations of its proscribed weapons programmes, they did not know how deeply those programmes had been integrated in Iraq's military-industrial infrastructure. Facilities involved in

proscribed programmes had multiple links to other military-industrial facilities and benefited from their support. This can be illustrated by the following examples:

(a) A variety of establishments specializing in conventional ammunitions were involved in the design and production of munitions and their components for Iraq's chemical weapons programme; some of these munitions were later adapted by Iraq's biological weapons programme as delivery means of biological warfare agents;

(b) Heavy mechanical engineering facilities produced chemical process and biological equipment for the chemical and biological weapons programmes, as well as tools and parts for the nuclear programme and missile projects;

(c) Civil engineering and construction of almost all facilities involved in proscribed weapons programmes was accomplished by a construction company that belonged to Iraq's military-industrialization authority.

87. The Iraqi military-industrial authorities also utilized the resources and capabilities of civilian industries for proscribed weapons programmes. Thus, in 1990, the Ministry of Industry and Military Industrialization took over from the Ministry of Agriculture two civilian facilities, the foot-and-mouth disease vaccine plant at Al Dawrah and the Agricultural Research and Water Resources Centre at Fudaliyah, which were then used for Iraq's biological weapons programme for the production of biological warfare agents.

88. The centralized management of proscribed weapons programmes enabled Iraq to utilize the expertise, resources and capabilities of individual programmes in support of other programmes. The following are examples of such horizontal links between different proscribed programmes:

(a) Iraq's chemical weapons programme was, inter alia, involved in the development of technology to manufacture missile fuel, in toxicological evaluation of a toxin produced by the biological weapons programme, in the weaponization of biological munitions and in the production of radiological bombs;

(b) Iraq's missile projects produced special missile warheads to be filled with chemical and biological warfare agents and Iraq attempted to develop a nuclear weapon delivery vehicle;

(c) Iraq's prime biological weapons establishment, TRC at Salman Pak, was involved in the development of binary chemical munitions for Iraq's chemical weapons programme.

89. It would not have been possible to establish multiple links between different proscribed weapons programmes and support to those programmes provided by other establishments if the verification process had been limited to the boundaries of an individual discipline. It was primarily owing to the multidisciplinary nature of the mandate and the consequent multidisciplinary approach to verification implemented by the inspectors that the extent of integration of proscribed programmes into Iraq's military-industrial infrastructure was discovered and unravelled.

90. Given the large degree of assimilation of technical resources and capabilities in Iraq's State-run economy that were used for proscribed weapons programmes, the question often arose as to what was directly relevant to proscribed programmes and

weapons. The answer to this question was a matter of frequent dispute between the inspectors and Iraqi authorities.

91. More than a dozen years of inspection and verification experience in Iraq by the United Nations inspectors has resulted in some important lessons learned and have also highlighted some dilemmas for an inspection regime. Experience by United Nations inspectors showed that one needs to look into all facilities, activities, items and materials associated with the establishments and facilities involved in past proscribed programmes to ascertain whether they are relevant to proscribed weapons. For example, in order to assess whether munitions production facilities are capable of modifying conventional munitions to include a chemical or biological warfare agent fill, it is necessary to understand the technical parameters of many of the conventional munitions available and to inspect both, some of these conventional munitions and their associated production facilities. However, by inspecting these, UNMOVIC risked being accused by Iraq of letting the inspectors move beyond the limits of their responsibility and mandate. The experience of the verification process in Iraq shows that it is difficult, without good knowledge and understanding of the scale and scope of proscribed programmes, to implement the full scope of effective verification.

III. Iraq's procurement for its weapons of mass destruction programmes[1]

A. Scope and role of procurement from the 1970s to 1990

92. In the early 1970s, Iraq embarked on a programme to modernize its industrial infrastructure and upgrade its armed forces. It created a military-industrial complex that incrementally incorporated weapons programmes which were heavily dependent on imports of foreign technology, arms, equipment, tools, parts and materials. The foreign assistance varied from supplies of items and sales of licensed technology to the construction of turnkey facilities in Iraq. With total control over Iraq's considerable oil resources and ongoing development of the petrochemical industry, the Government of Iraq was perceived as a solid business partner by its foreign suppliers.

93. In the course of investigation and verification by UNSCOM and UNMOVIC, it was established that in the period from the mid-1970s to 1990, more than 200 foreign suppliers had provided major critical technology, equipment, items and materials that were directly used by Iraq for its chemical warfare, biological warfare and missile programmes. The suppliers included governmental agencies and organizations, private companies and individuals who acted as brokers and middlemen. About 80 branches of foreign banks outside of Iraq were involved in transactions related to those acquisitions. In addition, dozens of trans-shipment companies were involved in the delivery of items and materials to Iraq. While there were cases where suppliers were aware of the final end-use of equipment and

[1] The information supplied in the present document has been limited to what is relevant to the mandate of UNMOVIC: chemical and biological weapons and delivery systems with a range greater than 150 km.

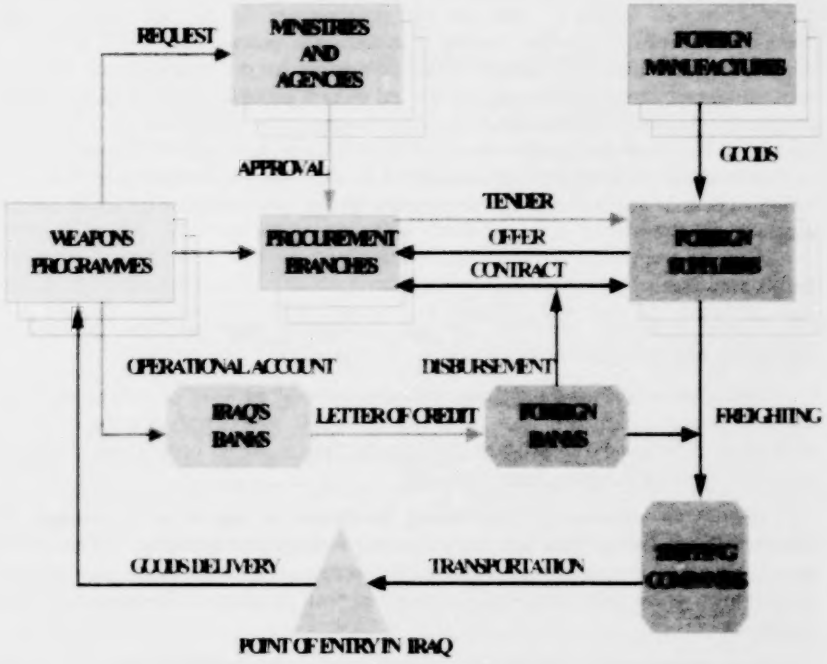
materials delivered to Iraq, there were also cases where the providers were unaware of the intended end-use or end-user of the items they sold.

94. From the 1970s to the mid-1980s, Iraq procured technology, equipment and materials from foreign suppliers, manufacturers and distributors. During this period, there were no international controls over the export of dual-use chemical and biological items or missile technology.

95. The mechanics of the procurement were relatively simple at that time. They involved the creation of operational accounts in Iraqi banks, the Central Bank of Iraq and the Rafidain Bank, corresponding accounts in foreign banks, direct interactions with prospective suppliers and the preparation and execution of contracts. The shipping of goods to the point of entry in Iraq was normally the responsibility of suppliers (see chart 2 below).

Chart 2

Mechanics of Iraq's procurement for its weapons programmes from the 1970s to the mid-1980s



1. Tightening trade controls

96. In 1984, in response to the findings of the United Nations special investigatory mission that chemical weapons had been used in the Iran-Iraq war, a number of Governments introduced systems of licensing to govern the export of some chemicals that could be used for the production of chemical weapons. In 1985, a group of countries that came to be known as the Australia Group collaborated on developing and implementing such measures as an informal mechanism to harmonize measures taken individually. Those measures allowed exporting or trans-shipping countries to minimize the risk of unknowingly assisting chemical weapons proliferation. Additional measures involving the licensing of the export of dual-use chemical and biological equipment and related technology were introduced by members of the Australia Group later in the 1980s.

97. The Missile Technology Control Regime (MTCR) was established by seven States in 1987 as an informal and voluntary group of countries that decided to coordinate national export licensing efforts as a measure of preventing proliferation. The aim of MTCR is to restrict access to missiles, complete rocket systems, unmanned aerial vehicles and related technology for those systems capable of carrying a 500 kg payload at least 300 km and systems intended for the delivery of weapons of mass destruction.

98. As Iraq has acknowledged, measures undertaken by members of the Australia Group, MTCR and other individual States significantly affected the development of Iraq's chemical, biological and missile programmes in the late 1980s. Iraq's chemical warfare programme started to experience procurement difficulties, and thus shortages in precursor chemicals and equipment for the production of chemical warfare agents, due to the newly introduced export controls. Its biological warfare programme failed in its attempts to procure fermentation equipment for a dedicated biological warfare production facility. MTCR had a negative impact on the implementation of Iraq's project to develop a two-stage missile jointly with a foreign country and slowed down progress in the development of other missile projects.

2. Iraq's response

99. Those measures, however, did not completely stop the flow of dual-use equipment and materials to Iraq owing to the following:

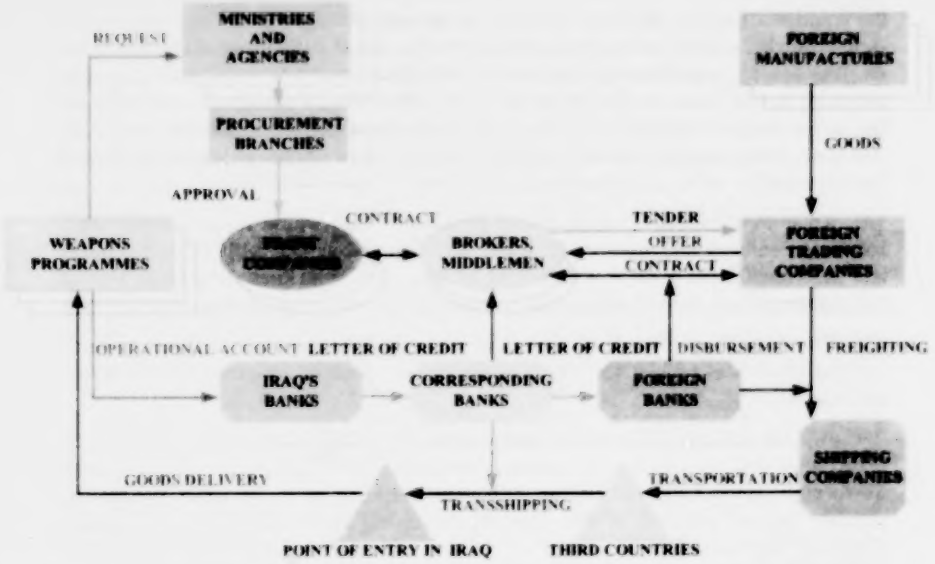
(a) Iraq established a sophisticated procurement network consisting of a long chain of brokers, intermediaries, bank accounts and transportation companies that enabled it, if necessary, to procure items using false end-user certificates issued for non-Iraqi third parties (see chart 3 below);

(b) After experiencing increasing problems in importing technology and materials from States that had implemented appropriate licensing systems, Iraq largely switched its procurement efforts to companies or subsidiaries that operated in countries where such measures had not yet been developed, introduced or fully implemented;

(c) Mindful of the difficulties it had experienced in the acquisition of dual-use equipment and materials and the likelihood that such difficulties would increase in the future, Iraq attempted to procure and store some items in excessive quantities in order to secure and meet possible future needs.

Chart 3

Iraq's procurement through brokers and middlemen from the mid-1980s to 1990



100. Consequently, in order to continue the acquisition of goods, Iraq tried to adjust its procurement network to meet emerging international trade norms. Those changes involved the use of legitimate commercial organizations in Iraq, such as the State Organization for Oil Refineries and Gas Industry, and governmental trading agencies and companies, such as the Technical and Scientific Materials Importation Division, as front companies for the procurement of dual-use items and materials. The State Organization for Oil Refineries and Gas Industry handled contracts for Iraq's chemical warfare programme under the cover of the oil industry, and the Technical and Scientific Materials Importation Division was an acquisition unit to support activities within TRC, which included Iraq's biological warfare programme.

101. Depending on the nature of the goods procured, acquisitions were also made through other agencies that could better provide a cover for them. For example, some laboratory equipment and materials used by the biological warfare programme were procured through the Ministries of Agriculture, Oil and Health, and some machine tools for missile projects were procured through the Ministry of Industry.

102. Further adjustments continued, including the expanded use of networks of brokers and middlemen. Operating from offices registered in third countries where end-user certificates were issued, the brokers and middlemen acted between Iraq's front importation companies and foreign trading companies, thus preventing Iraqi companies from directly contacting foreign manufacturers and affiliated official distributors. Foreign trading companies, acting on behalf of brokers and middlemen, then procured the required goods from manufacturers and distributors. To cover the

final destination of goods, brokers and middlemen arranged for multiple trans-shipments by freight handlers. The goods were not delivered to Iraq but to a neighbouring country in the region, where they were transported to Iraq by an Iraqi shipping company acting on behalf of the end-users or their agencies.

103. The length of the procurement chain depended on the geographic location of the manufacturers and the existing trade regulations in their countries. Accordingly, the creation of additional bank accounts in multiple foreign banks was required to support such a sophisticated procurement mechanism at each phase and location of its functioning, significantly increasing the final cost of items and materials procured in this manner. Iraq procured over 1,000 tons of precursor chemicals for the production of chemical warfare agents using the mechanism outlined above. In one case, Iraq procured several hundred tons of a key chemical precursor from a foreign supplier using a false end-user certificate.

104. To bypass extensive procurement procedures that would leave a paper trail, Iraq often entered into cash deals, when they were accepted, with foreign brokers and individuals. The cash was delivered to Iraq's governmental institutions abroad and disbursed by Iraqi officials affiliated mainly with the Iraqi Intelligence Service.

105. The successful procurement of dual-use foreign technology, equipment, items and materials was crucial for Iraq's development of all of its proscribed weapons programmes:

(a) In the area of chemical weapons, most of the production plants and units constructed and used by Iraq to manufacture chemical warfare agents were designed by foreign contractors (but not as dedicated chemical weapons agent production plants). The vast majority of the chemical processing equipment came from foreign suppliers, and about 95 per cent of all precursor chemicals used for the production of chemical warfare agents was procured outside Iraq;

(b) In the area of missiles, Iraq relied on imported components for its indigenous missile systems; Iraq also imported machinery, tools and raw materials in an attempt to produce indigenously some missile systems and components;

(c) In the area of biological weapons, equipment used for biological warfare research and development, most equipment used in the production of biological warfare agents and bacterial isolates and other items, such as bacterial growth media, were procured from foreign suppliers. In contrast with chemical weapons, for which specific equipment was procured directly for their production, because of the problems involved with imports during the late 1980s, the equipment used for the production of biological warfare agents was largely taken from facilities that had earlier acquired the equipment for legitimate purposes. In addition, Iraq utilized civilian facilities, including a plant constructed by a foreign contractor to produce vaccine against foot-and-mouth disease, for the production of biological warfare agents.

3. Munitions

106. Iraq's chemical warfare programme relied mainly on the adaptation of conventional munitions for the dispersion of chemical warfare agents. Those munitions were imported initially from foreign sources as either empty conventional munitions or as specifically designed chemical weapons. Iraq soon developed a significant capability to produce indigenously many types of chemical warfare

munitions. The munitions chosen by Iraq for its chemical warfare programme were linked to the availability of suitable delivery systems, such as artillery guns, rocket launchers, aircraft and missile systems. Some of those munitions were later used by Iraq for biological warfare agents. Thus, the acquisition of foreign conventional munitions, their parts and components and means to manufacture them was another part of the procurement efforts in support of Iraq's proscribed weapons programmes.

107. In the early 1980s, Iraq contracted a foreign company to perform a number of static and dynamic field tests, outside Iraq, of conventional artillery projectiles filled with materials to simulate chemical weapons and artillery rocket warheads designed specifically to hold liquids of a density similar to the chemical agent mustard. The performance characteristics, such as the nature and extent of dispersion of the liquid payload, were evaluated as were the optimal parameters, such as the burster tube length and charge strength, thereby indicating the prospective use of those munitions. After the tests had confirmed the suitability of such shells and warheads, Iraq procured assemblies for 50,000 artillery projectiles and 25,000 rockets from that company for its chemical warfare programme.

108. Another company supplied Iraq with an additional 35,000 pieces of similar artillery projectiles. A third foreign company supplied Iraq's chemical warfare programme with 22,000 rockets with several different versions of warheads, some designed to hold a payload with characteristics that matched particular chemical warfare agents Iraq had produced. The same company also supplied Iraq some 6,500 rockets with warheads designed specifically to hold the chemical warfare agent sarin.

109. While continuing to import munitions that were suitable for its chemical warfare programme, Iraq also tried to achieve a higher degree of self-reliance in munitions production. Iraq was able to produce indigenously artillery and bomb casings and to assemble a variety of aerial bombs using manufacturing equipment and components that had been imported for the production of conventional munitions.

4. Procurement data

110. Given the critical role that dual-use technology, equipment and materials acquired from foreign suppliers played in Iraq's development of its WMD programmes, the evaluation of procurement data proved to be one of the major tools for the investigation, mapping and verification of Iraq's declarations concerning such programmes.

111. Procurement data comprise information, documents and records relating to specific actions taken by Iraq for the acquisition of items and materials. They include communications and negotiations with prospective suppliers; notes of meetings to discuss requirements; tenders describing services required and items and relevant specifications; offers made by suppliers; and the preparation and implementation of contracts, including insurance documents, bills of lading, trans-shipment information, customs documentation and final delivery certifications of contract implementation by end-users. Procurement information is also available through financial statements, such as the opening of operational accounts in corresponding banks issuing letters of credit and a variety of money transfers from the accounts of end-users in Iraq to Iraqi banks involved in the transactions.

112. The experience of United Nations verification in Iraq shows that despite Iraq's extensive concealment policy and practices, it was still possible to find evidence of its procurement activity. The nature of the procurement process was such that multiple fingerprints of past acquisitions existed not only in Iraq at various organizations, including ministries, agencies, establishments and banks, but also outside Iraq, in countries of suppliers and third countries through which goods were trans-shipped. United Nations inspectors obtained data from the following sources:

(a) The major source of information at the beginning of the verification process was the procurement data provided by the Governments of former suppliers to Iraq. These data provided an important insight into Iraq's acquisitions in connection with its proscribed weapons programmes and helped determine the completeness of Iraq's declarations. However, the degree of cooperation by Member States in providing such information varied, and several important aspects of Iraq's procurement activities could not be clarified with former suppliers and their respective Member States owing to their unwillingness to disclose the nature and extent of their assistance to Iraq's weapons programmes. The demonstrated ability of the United Nations verification body to maintain the confidentiality of information provided was an important prerequisite for Member States to maintain the supply of such information. Member States provided their most sensitive procurement information only after they had been satisfied that the United Nations verification body was successfully securing such information;

(b) Direct contacts with former suppliers (legal entities and individuals) established with the support of Member States and independently by the United Nations provided first-hand information on Iraq's requirements with regard to specific items and materials, their types and quantities and any special adaptations, and on the performance of contracts Iraq had concluded;

(c) Another important source of information was data collected by individual Member States and shared with the United Nations inspectors. That data included very specific information on contacts among various Iraqi agencies, facilities and third parties, middlemen and suppliers outside Iraq;

(d) Another important source of information was the evaluation and analysis of the procurement data provided by Iraq in its declarations. While Iraq was aware that the United Nations inspectors had obtained information from some of its foreign suppliers and other sources, it was not aware of the exact nature or scope of the information provided. As a result, in many cases Iraq unilaterally provided information and identified suppliers that had not been known to the inspectors;

(e) Through on-site inspection activities, inspectors were able to identify the origin of the items and materials and the manufacturers and supplying organizations from brands, serial/model numbers, labels, packaging and shipping markings on crates that often contained the code identification of the end-users. They included chemical-processing and biological equipment, precursor chemicals, bacterial growth media and munitions acquired from foreign suppliers;

(f) Document searches at various facilities in Iraq, including ministries, agencies, companies and facilities that were involved in different stages of the procurement process, from the preparation of tenders and relevant specifications to the acquisition of goods and their shipment to Iraq, provided information;

(g) Inspections of bank branches in Iraq and the evaluation of the accounts of organizations and establishments were other sources of information. To be more productive, that process required preliminary knowledge and understanding of the organizational structure of Iraq's proscribed programmes, their affiliation, budget and finance. Codes of bank accounts, contracts and letters of credit contained distinctive identifiers of budgeting organizations that financed the procurement;

(h) Interviews with Iraqi personnel at all levels involved in procurement, from senior managers to the truck drivers who transported the procured goods, also proved to be an effective tool in obtaining relevant information.

113. In several instances, procurement information was absolutely critical and enabled United Nations inspectors to make significant progress in the verification of Iraq's proscribed programmes:

(a) In the missile area, information provided by a former foreign supplier on Iraq's acquisition of operational missiles, including the quantity and serial numbers, was critical in the efforts to establish the material balance of those missiles;

(b) In the chemical area, very specific procurement data provided by suppliers helped inspectors identify dozens of items of undeclared chemical-processing equipment that had been procured for Iraq's chemical warfare programme;

(c) In the biological area, information provided by a former supplier, who had been identified through the examination of the original packaging of materials found in Iraq, included data on the specific types and quantities of bacterial growth media that Iraq had procured from it. That information was used by United Nations inspectors in pressing Iraq to disclose elements of its offensive biological warfare programme, which Iraq reluctantly did in 1995.

B. Sanctions and procurement

1. Period from 1991 to 1995

114. Following Iraq's invasion of Kuwait in 1990, the Security Council adopted a number of resolutions that imposed trade sanctions and weapons prohibitions and laid the basis for United Nations verification of Iraq's compliance with its obligations not to use, develop, construct or acquire weapons of mass destruction and related programmes and to eliminate its holdings thereof.

115. It became apparent that even under the sanctions, certain dual-use items, such as vaccines, were being exported legitimately to Iraq. It is also known that during this period Iraq negotiated with foreign companies for the possible procurement of a variety of military and dual-use items, but there is no evidence that any of the items and materials sought during that period were actually used by Iraq in proscribed weapons programmes. Therefore, an export/import monitoring mechanism had to be introduced and made operational to cover such issues.

116. During the period from 1993 to 1995, a foreign individual acting under contract with several of Iraq's missile establishments and in close collaboration with the Iraqi Security and Intelligence Service visited three countries in order to obtain parts and components of range-proscribed missile guidance and control systems. In one country, he was able to find suppliers of those goods, to establish an office, to

open multiple bank accounts and to procure and ship to a third country various missile parts and components through a chain of private companies and intermediaries. One of the shipments was intercepted by the authorities of the third country en route to Iraq. Subsequently Iraq handed over to the United Nations missile parts and components from previous deliveries.

2. Period from 1996 to 1998

117. In 1995, the Security Council authorized Member States to import petroleum and petroleum products originating in Iraq in order to fund the provision of humanitarian goods. It had already been noted that even under sanctions, certain dual-use goods, such as vaccines, had been imported legitimately into Iraq. In view of the increase in trade that the sale of oil would likely bring, it was decided to pursue the establishment of an export/import mechanism, as called for in the monitoring plan. In 1996, such a mechanism was established through Council resolution 1051 (1996) of 27 March 1996. It provided information to United Nations inspectors on exports and imports of relevance and was expected to be operational regardless of the status of sanctions.

118. During the period from 1996, when the implementation of the mechanism began, up to the withdrawal of the United Nations inspectors from Iraq in 1998, there was no evidence that Iraq had attempted to use any of its declared imports of procured goods for proscribed programmes. However, several instances of the procurement by various Iraqi facilities of declarable dual-use items and materials outside the scope of the mechanism were noticed by the inspectors. Iraq explained that those foreign goods had been obtained from local private trading companies, which it described as procuring from the "local market". The so-called local market was a sign of the development in Iraq of new procurement patterns involving private entrepreneurs and their networks rather than governmental institutions and trading companies. That procurement pattern was further developed and was used frequently in Iraq's acquisitions after the departure of inspectors from its territory in December 1998.

3. Period from 1999 to 2002

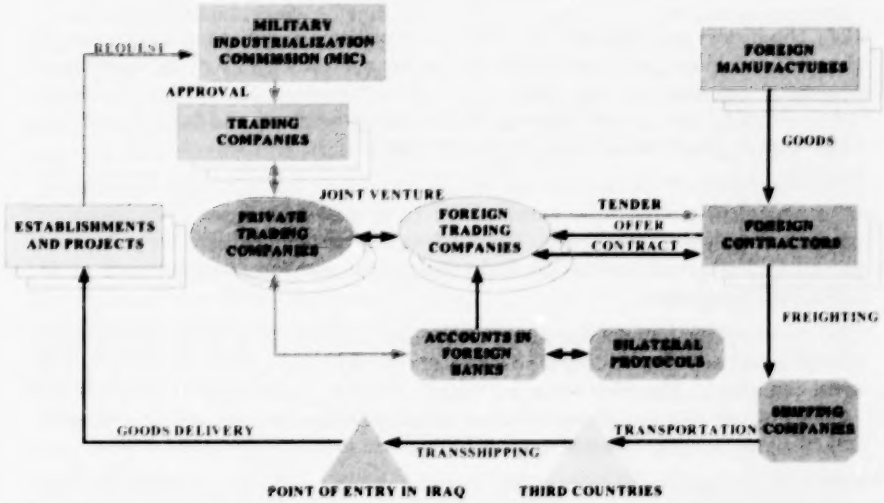
119. During the absence of the United Nations inspectors in Iraq from 1999 to November 2002, Governments of suppliers continued to provide to UNSCOM and UNMOVIC notification of exports to Iraq as required under the export/import monitoring mechanism. However, Iraq did not provide its corresponding notifications to the United Nations during that period. Nevertheless, prior to the resumption of inspection activities in November 2002, Iraq provided aggregated data for that period on the procurement of items and materials subject to notifications in a set of its semi-annual monitoring declarations. Iraq also provided UNMOVIC with the notifications that had been continuously prepared by it from 1999 to 2002 but not sent to the United Nations.

120. A review of the semi-annual monitoring declarations, the procurement information obtained during inspections, interviews, and data retrieved through forensic computer exploitation indicates that, in addition to the development of the local market mentioned earlier, during the period from 1999 to 2002, Iraq had rebuilt and further developed its procurement network for the acquisition of foreign materials, equipment and technology. The network consisted of State-owned trading

companies established and controlled by MIC, with branches in foreign countries; the Iraqi private sector and foreign trading companies operating in Iraq and abroad; multiple intermediaries; chains of foreign suppliers of items and materials; bank accounts; and transportation companies. In several instances, the Iraqi State-owned trading companies had shares in foreign trading companies or were closely affiliated with local private trading companies (see chart 4 below).

Chart 4

Iraq's procurement through governmental and private trading companies from 1999 to 2002



121. Despite the Council's prohibitions, from 1999 to 2002 Iraq procured materials, equipment and components from abroad for use in its missile programmes. In several instances, the items procured were used by Iraq for the production of Al Samoud-2 missiles that were determined by UNMOVIC in February 2003 to be proscribed. At least 380 SA-2 missile engines were imported for this programme by Iraq's prime missile establishment through an Iraqi State-owned trading company controlled by MIC and through a local Iraqi trading company and a foreign trading company.

122. The same Iraqi governmental trading company was involved, through a contract with two foreign private companies, in procuring components and equipment for the manufacture and testing of missile guidance and control systems, including inertial navigation systems with fibre-optic and laser ring gyroscopes and Global Positioning System (GPS) equipment, accelerometers, ancillary items and a variety of production and testing equipment. One Iraqi trading company was also involved in the procurement (through private trading companies) of different pieces of missile-related production equipment and technology. In addition, several foreign

private subcontractors were responsible for the implementation of specific parts of the general contract.

123. From 1999 to 2002, Iraq procured a variety of dual-use biological and chemical items and materials without United Nations authorization. They included the acquisition of some corrosion-resistant chemical processing equipment and biological research equipment, such as DNA sequencers, that were used by Iraq for legitimate purposes. Although the goods were acquired by Iraq outside the framework of the mechanisms established under Security Council resolutions, most of them were declared by Iraq to UNMOVIC in October 2002, when Iraq submitted its backlog of semi-annual monitoring declarations.

C. Importance of procurement verification

124. The history of Iraq's development of its ballistic missile programme and its chemical and biological weapons shows that the acquisition of foreign technology, equipment and materials was critical for those programmes. The forms of foreign procurement by Iraq varied from supplies of individual items and sales of licensed technology to the construction of turnkey facilities.

125. The experience of international verification in Iraq exemplifies the importance of procurement verification as one of the tools used to achieve a disclosure of proscribed weapons programmes. Despite Iraq's extensive concealment policy and practices, it was still possible to find procurement activity as an indicator of an undeclared programme.

126. Although the introduction of export licensing by individual States significantly slowed down and limited Iraq's procurement efforts prior to 1991, it did not stop them completely. The provisions involving only the licensing of exports on the grounds of end-user certificates without on-site verification were not able to solve fully the problem of possible shipments of dual-use items and materials to Iraq.

127. Iraq has demonstrated its ability to make adjustments and modifications to its procurement techniques to overcome trade restrictions, to a certain degree, even under sanctions. Such an ability demonstrated that a combination of effective export control measures taken by all potential suppliers, coupled with an international mechanism for export/import notifications of dual-use items to Iraq and on-site verification, was required in order to provide a sufficient degree of confidence that dual-use items and materials were not used for proscribed purposes.

IV. Iraq's chemical weapons programme

A. Overview

128. Chemical weapons were the first area of WMD explored by Iraq. In 1971, Iraq's Chemical Corps established a laboratory-scale facility at Al-Rashad, in the Baghdad area, to gain practical experience in the synthesis of chemical warfare agents and to evaluate their effects. Although production of laboratory quantities (gram to kilogram) of chemical warfare agents could have been justified for defensive purposes, such as the calibration of detection instruments and the testing of protective equipment, the work of the laboratory also constituted a necessary step

in the training of a national cadre for future dedicated chemical weapons research and production. In addition, it contributed to the creation of relevant support infrastructure and a system for the acquisition of equipment and materials.

129. Thus, the functioning of a laboratory in the period from 1971 to 1973 can be considered a preparatory stage in Iraq's familiarization with chemical weapons technology, although there is no clear evidence concerning Iraq's intentions at that time. In 1974, this laboratory came under the auspices of a newly created organization, the Al-Hazen ibn al-Haitham Institute, which was subordinated to Iraq's security and intelligence agencies.

130. By the end of 1974, the chemical weapons work at the Al-Hazen ibn al-Haitham Institute was expanded in an attempt to produce chemical warfare agents on a larger (tens of kilograms) scale. Following the progress in the scaling up of the synthesis of chemical warfare agents, the Al-Hazen ibn al-Haitham Institute decided to expand its chemical laboratory complex inherited from the Chemical Corps and to place larger-scale production units at a new site located in a remote desert area south of the town of Samarra. In 1975, the construction of four chemical weapons production plants commenced. These included a plant for the production of the chemical warfare agent mustard, a plant to manufacture nerve agents, tabun and sarin, and two multipurpose plants for the production of precursor chemicals. The construction work, however, stopped after the closure of the Al-Hazen ibn al-Haitham Institute in 1978.

131. A large-scale chemical weapons programme was established by Iraq in 1981, after the beginning of the Iran-Iraq war, when Iraq faced defeat in the face of Iran's overwhelming manpower advantage. The goal was to produce and supply the armed forces with significant quantities of chemical weapons that could be deployed quickly.

132. Iraq's military chemical weapons programme progressed rapidly. From 1981 to 1983, Iraq expanded production at the Al-Rashad facility and developed the chemical weapons complex at the Samarra site started by the Al-Hazen ibn al-Haitham Institute. Iraq constructed several chemical weapons production plants and assembled other critical elements of infrastructure at this site. By the end of 1984, Iraq had produced hundreds of tons of chemical warfare agents and supplied several thousand filled chemical weapons munitions to Iraq's armed forces. Iraq was not able to transcend some critical technological barriers, such as the quality of some chemical warfare agents produced. However, despite these flaws, the use of chemical weapons had, according to Iraq, achieved its major purpose and made a significant impact on the outcome of the Iran-Iraq war.

133. The chemical weapons programme required access to foreign technology, equipment and raw materials because in the early 1980s, Iraq did not have indigenous capabilities to manufacture chemical process equipment and precursors for the production of chemical warfare agents. A convincing legitimate cover story was needed to engage outside contractors and suppliers. Therefore, the chemical weapons programme began to operate under the facade of the State Establishment for Pesticide Production (SEPP).

134. In the 1970s and 1980s, the production of a second generation of agricultural pesticides in terms of technology, equipment and raw materials, most closely

corresponded to the requirements for the production of chemical warfare agents. In addition, Iraq had legitimate needs for pesticides for its growing agricultural sector.

135. In general, Iraq did not develop its own methods for the production of chemical warfare agents. At the beginning of the programme, its main concept was to replicate, at an industrial scale, known foreign methods and techniques of the production of chemical warfare agents using commercially available technology, equipment and raw materials. Later, however, for some agents (for example VX) Iraq applied modified processes to suit its own capabilities.

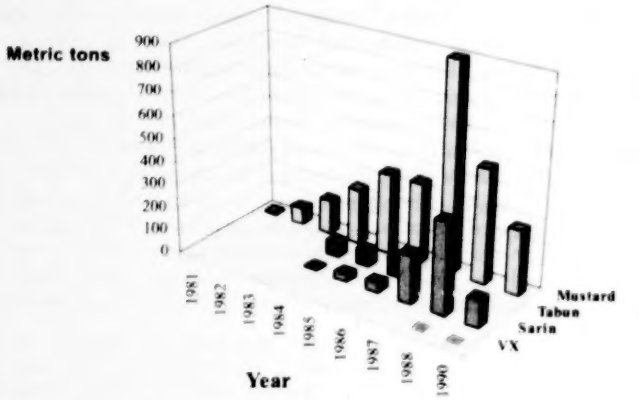
136. Training in foreign institutions, open source publications, foreign patents, international conferences and forums were major sources of information on basic chemical weapons production technology for Iraq. This information was first tested by Iraq at laboratory level to identify and adjust unknown parameters of the synthesis of chemical warfare agents that could not be found in open sources, such as kinetics of chemical reactions, combinations of catalysts, equipment specifications and scale-up procedures.

137. During the Iran-Iraq war, Iraq's chemical weapons programme was not able to produce chemical weapons of sufficient quality to be stored as operational and strategic reserves. To overcome this limitation, after the end of the war, Iraq's chemical weapons programme was focused on the improvement of previously produced agents and on the development of more powerful and better quality agents suitable for long-term storage. These, among others, included Iraq's efforts to produce binary weapons and the chemical warfare agent VX. After 1988, Iraq also initiated several projects to build indigenous capabilities for the production of critical chemical warfare agent precursors. These efforts were interrupted by the Gulf war in 1991.

138. According to Iraq's declarations, in the period from 1981 to 1991, the chemical weapons programme produced approximately 3,850 metric tons of the chemical warfare agents mustard, tabun, sarin and VX, as shown in chart 5 below.

Chart 5

Production of lethal chemical weapons agents, as declared by Iraq*



	1981	1982	1983	1984	1985	1986	1987	1988	1990
VX								2.4	1.5
Sarin				5	30	40	209	394	117
Tabun				60	70	80			
Mustard	10	75	150	240	350	350	899	494	280

* Iraq declared no bulk production in 1989.

B. Weaponization of chemical warfare agents

139. Efforts by SEPP/Muthanna State Establishment to weaponize Iraq's chemical warfare agents relied mainly on the adaptation of conventional munitions for the dispersion of chemical warfare agents. In most cases, these adaptations were performed by or coordinated with Iraq's other military-industrial establishments. The critical components that made these munitions technically suitable for chemical weapons applications were optimized burster charges of specific size and shape and other components, such as sealing rings, filling ports and agent containers.

140. In order to achieve self-reliance in munitions, Iraq's chemical weapons programme produced indigenously munitions casings, including a variety of aerial bombs, using raw materials for the production of conventional munitions and manufacturing equipment procured from foreign suppliers. The production of chemical weapons munitions was linked directly to the design and production of conventional munitions by Iraq.

141. The prime determining factor in the selection of munitions for Iraq's chemical weapons programme was sustainable means of delivery and munitions capable of fulfilling operational goals. The efficiency of dissemination of chemical warfare agents for munitions was considered by Iraq in relation to operational goals.

However, the optimal efficiency of munitions was not in itself the prime criteria for the selection of munitions for use with a chemical warfare agent.

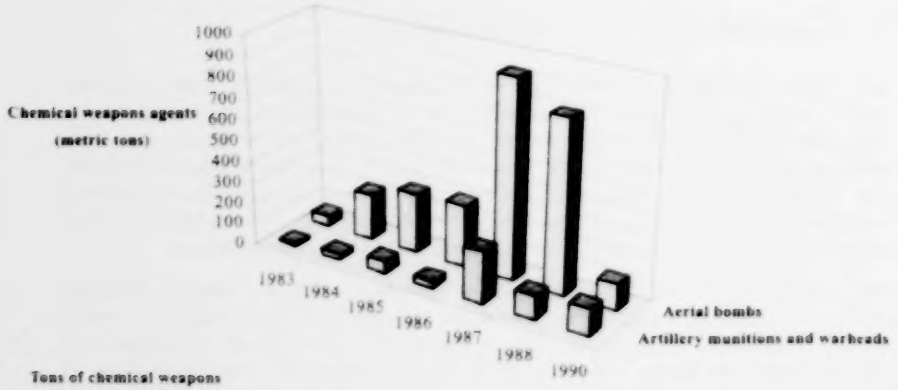
142. In the methods and "rules" of chemical weapons use, Iraq followed known principles. Battle scenarios prepared by Iraq's armed forces envisaged both defensive and offensive operations and therefore comprised requirements for different types of chemical munitions to assure operational flexibility. Thus, in general, artillery projectiles and aerial bombs filled with the persistent chemical warfare agent mustard were thought to be used for area denial to prevent the movement of attacking enemy troops in the course of defensive operations. Chemical 122 mm rockets filled with the non-persistent chemical warfare agent sarin were deployed against enemy positions on the front line and used in order to break the enemy defences, in preparation for offensive operations and counter attacks. After chemical attacks, areas fired upon with chemical rockets containing non-persistent agents, could be crossed by attacking Iraqi troops. Aerial bombs with both persistent and non-persistent agents could be used against multiple targets beyond the front line. Chemical warheads for ballistic missiles developed at the very end of the programme were considered to be strategic weapons.

143. Iraq did not have special military units dedicated for the use of chemical weapons. Regular military combat units were to receive and use chemical weapons if necessary, under special directives. It is probable that such directives were issued during the Iran-Iraq war under the name of the President of Iraq.

144. According to Iraq, of the total of some 3,850 metric tons of chemical warfare agents produced, approximately 3,300 tons of agents were weaponized in different types of aerial bombs, artillery munitions and missile warheads as detailed in chart 6 below.

Chart 6

Weaponization of lethal chemical weapons agents, as declared by Iraq



Tons of chemical weapons agents weaponized/Year*	1983	1984	1985	1986	1987	1988	1990
Artillery munitions and warheads	10	27	61	32	243	110	123
Aerial bombs	53	220	284	292	931	807	126

* Iraq declared no large-scale production or weaponization for 1989. It produced an unknown number of weapons (probably small) in 1981 and 1982.

145. In the period from 1981 to 1991, Iraq weaponized some 130,000 chemical munitions. Of these, over 101,000 munitions were used in combat, according to Iraq, in the same period.

146. Iraq declared that some 28,500 chemical munitions remained unused in Iraq as of January 1991. According to Iraq, of these, about 5,500 filled munitions were destroyed by coalition forces during the war in 1991. Another 500 filled munitions were declared destroyed unilaterally by Iraq. These last two figures were partially verified by United Nations inspectors. The bulk of destruction of some 22,000 filled munitions, however, occurred under the supervision of the United Nations inspectors, in accordance with Security Council resolution 687 (1991), in the period from 1991 to 1994. During the collection of chemical weapons for destruction after the 1991 war, Iraq stated that it was not able to locate some 500 chemical munitions.

C. Destruction of Iraq's chemical weapons and related items

147. In accordance with Security Council resolution 687 (1991), large quantities of chemical weapons and related items and materials declared by Iraq were destroyed under United Nations supervision in a relatively short period, from 1991 to 1994, mainly at the Muthanna State Establishment, Iraq's former chemical weapons complex. This destruction included 22,000 filled and over 16,000 unfilled chemical munitions, 690 tons of chemical warfare agents (both bulk and weaponized), more than 3,000 tons of precursor chemicals and over 100 major items of chemical weapons production equipment.

148. The supervision of Iraq's destruction of its chemical weapons was one of the main achievements of the United Nations verification agency. It was the first chemical weapons destruction operation supervised by an international organization. It demonstrates the fact that, with utilization of the best expertise available and the development of optimal operating procedures, UNSCOM was able to ensure that this dangerous operation was conducted as rapidly as possible.

149. The United Nations supervision of the destruction operations was not limited to the presence of the United Nations inspectors at a destruction site and observation of the operations. It also included the evaluation and assessment of the destruction methods proposed by Iraq to meet the requirements of Security Council resolution 687 (1991) regarding public safety during the destruction, as well as technical expertise, guidance and actual support to Iraqi personnel involved in the destruction. To accomplish this, UNSCOM assembled a Destruction Advisory Panel comprising prominent international experts in the area of chemical weapons to consult on all aspects of the destruction. The intended destruction methods were also coordinated with the United Nations Environment Programme.

150. The following methods were used for the destruction of Iraq's chemical weapons and precursor chemicals:

(a) Destruction of the chemical warfare agent mustard and flammable precursors using an incinerator built by Iraq from items of equipment procured and used in the past by Iraq's chemical weapons programme. This incinerator at the Muthanna State Establishment was commissioned by UNSCOM;

(b) Destruction of the chemical warfare nerve agents, sarin and tabun, and some of their precursors, through hydrolysis using the facilities of the Muthanna State Establishment, under UNSCOM guidance;

(c) Destruction on an ad hoc basis through explosive venting and simultaneous burning of chemical munitions, damaged during the 1991 Gulf war. These munitions represented immediate health and environmental hazards and for safety considerations could not be transported to the designated destruction site at Iraq's former chemical weapons complex.

151. A dedicated UNSCOM team, the Chemical Destruction Group, was deployed to Iraq, where it was stationed from 1992 to 1994, to supervise and monitor destruction operations carried out by Iraq, including regular environmental monitoring. It also provided decontamination and medical support to Iraqi personnel involved in the destruction operations. Over 100 experts from 25 countries served with the Group during the period of its work in Iraq. Owing to the dangerous nature of the work and the hazard inherent in the destruction area, utmost attention was given to minimizing the health and environmental impacts of the destruction of chemical weapons and their components. The Group personnel suffered no serious injuries during destruction operations. The final sampling and analysis conducted by UNSCOM upon the completion of the destruction showed that no significant chemical weapons-related environmental hazards existed at the Muthanna State Establishment.

152. All hazardous waste resulting from the destruction of chemical weapons was safely sealed at several structures and areas of the Muthanna State Establishment with reinforced concrete and brick walls covered with earth. These included two bunkers, one of which was damaged by aerial bombardment in 1991 and contained 122 mm artillery rockets and munition remnants that had been filled with the nerve agent sarin. To maintain security and safety, in a signed protocol with UNSCOM, Iraq undertook to inspect the sealed structures at least once a month to ensure that the seals were intact and warning signs had not been removed, damaged or defaced for as long as Security Council resolution 715 (1991) remained in force.

153. Iraq's United Nations-supervised destruction of chemical weapons shows the importance of long-term continuity in site security and safety arrangements and hazardous materials disposal. The implementation of the protocol after the withdrawal of the United Nations inspectors from Iraq in March 2003 cannot be verified by UNMOVIC.

D. United Nations verification

154. Although a number of issues relating to Iraq's chemical weapons programme remain unresolved, the United Nations inspectors were able to identify the major parameters of this programme, its scope and the results achieved. These included elements of the programme that Iraq tried to conceal from the inspectors, such as its efforts to produce the chemical warfare agent VX and to retain a portion of equipment, instruments and materials procured for the chemical weapons programme in the past.

155. The experience of the verification of Iraq's chemical weapons programme shows that only an advanced verification system comprising various verification

tools and techniques is capable of uncovering undeclared activities. The analysis of procurement data revealed the acquisition of specific items and materials by Iraq; document searches resulted in the discovery of records of undeclared activities; interviews with Iraqi scientists and technicians helped to identify gaps in Iraq's declarations on specific issues; debriefings of defectors produced additional information that was not declared by Iraq; information from former suppliers to Iraq helped to corroborate procurement data; and sampling and analysis identified residues of undeclared materials, which, in combination with on-site inspections, led to the identification of the indisputable existence of undeclared activities. Combined expertise within the United Nations verification body was also critical for credible verification and assessment. In addition, the system of ongoing monitoring and verification provided assurance that chemical weapons production had ended in 1991 and was a strong deterrent to the resumption of proscribed activities thereafter.

156. The primary complex for the development and production of chemical weapons in Iraq was dismantled and closed under UNSCOM supervision. Inspectors identified other facilities with dual-use capabilities that were put under monitoring. Considerable progress was made in the verification of undeclared chemical weapons-related activities, such as Iraq's VX production activities and its efforts to retain a portion of chemical processing equipment and precursors procured in the past by its chemical weapons programme.

157. On the issue of VX, Iraq initially declared that it had carried out only laboratory research on this chemical warfare agent. By 1995, UNSCOM uncovered evidence that the scope of Iraq's activities on VX was much broader. Consequently, in 1996 Iraq declared the production of 3.9 tons of VX, the production of 60 tons of key VX precursors and the acquisition of some 650 tons of other precursors for the production of VX. Iraq acknowledged that it had decided to conceal various aspects of its VX activities from UNSCOM and declared that, in 1991, it had unilaterally destroyed all VX and its key precursors, as well as documents and records relevant to VX.

158. Concerning Iraq's efforts to retain chemical weapons-related equipment and materials, in 1997, the United Nations inspectors identified an additional 325 items of production equipment, 125 analytical instruments and 275 tons of precursor chemicals procured by the former chemical weapons programme and retained by Iraq. The identification of these materials was made on the basis of multiple pieces of evidence gathered by the inspectors.

159. The verification experience of UNSCOM and UNMOVIC shows that a country's documentation of its chemical weapons programmes is critical for verification, since physical evidence may no longer exist. The intentional elimination or concealment of documentary evidence dramatically decreases confidence in the inspected party and leads to ambiguities that may never be resolved satisfactorily.

160. Given the absence of complete production, storage and deployment records which, according to Iraq, were destroyed unilaterally, it was not possible for United Nations inspectors to verify fully Iraq's declarations regarding overall quantities of chemical weapons produced, used or retained. Verification of Iraqi declarations was made more difficult since the major part of the bulk chemical warfare agents produced and chemical munitions filled over the period of 10 years had been used in combat. With regard to chemical agents and munitions remaining in Iraq as of 1991,

since no stockpiles of such munitions or agents have been found either by United Nations inspectors or by the Iraq Survey Group or coalition forces, it appears that the vast majority of these had been declared by Iraq, identified by the inspectors and destroyed under international supervision. However, unilateral destruction by Iraq prolonged the verification process and left uncertainties regarding the types and quantities of weapons it destroyed.

161. A residue of uncertainty also remains with respect to chemical munitions that were lost, according to Iraq, after the 1991 Gulf war. The Iraq Survey Group quoted conflicting statements of former Iraqi officials, with one individual suggesting that some 500 155 mm munitions had been retained by Iraq and other officials insisting that they had actually been destroyed.

162. Iraq's regular military units in theatres of operation received and used both conventional and chemical weapons. Because of the rapid relocation of many of these units and the dozens of facilities involved in the handling of those weapons, there is a possibility that chemical munitions have been inadvertently mixed with conventional weapons. Moreover, some chemical munitions filled with chemical warfare agents were marked as standard conventional weapons, which made their determination as chemical munitions problematic not only for United Nations inspectors and later the Iraq Survey Group personnel, but also for Iraq itself.

163. From information collected by the inspectors in Iraq, UNMOVIC assessed that depending on the munitions models, types of chemical warfare agents, dates of production and filling and storage conditions, some chemical munitions, if remaining in Iraq, might still retain relatively high-purity chemical warfare agents, like mustard. Other munitions would contain degraded chemical warfare agents, binary components or only their residues.

164. The experience of verification of Iraq's chemical munitions also showed that to recognize the subtle modification used to convert conventional munitions, into chemical munitions a detailed understanding of the original munitions materials, design and manufacturing process was required. Understanding all conventional delivery means available to Iraq is another area essential for the recognition of Iraq's chemical weapons munitions, their distinctive parts and components.

165. Iraq is rich in natural resources such as oil, natural gas and minerals, including phosphate rock and sulphur. By-products from processing these reserves may be used for some chemical warfare agent precursors. Taking into account Iraq's pre-1991 efforts to achieve self-reliance in the production of critical chemical warfare agent precursors from materials available in Iraq, it was critical for the monitoring system to also cover a portion of Iraq's petrochemical and mining complex to prevent the conversion of commercial chemicals and capabilities for proscribed purposes.

V. Iraq's missile-related programmes

A. From imported foreign missiles to indigenous missile projects

166. In the period from the early 1970s to the late 1980s, in the course of the modernization of its armed forces, Iraq procured a variety of foreign missile and rocket systems. These included, among others, the SCUD-B surface-to-surface

missile system with a range of up to 300 km, the FROG-7 surface-to-surface rocket system with a range of up to 70 km, the SA-2 surface-to-air missile system with an effective maximum range of over 40 km against aerial targets and several variants of anti-ship cruise missiles.

167. With respect to surface-to-surface missile capabilities, the first imported missiles, warheads, launchers, fuels and ground support equipment were received by Iraq in 1974. Subsequently, two missile units that marked the foundation of Iraq's missile force were formed in 1975. Missile Unit 135, later known as Missile Brigade 225, was equipped with FROG rocket systems while Missile Brigade 224 operated SCUD missile systems. The two units became fully operational in 1976 after their personnel had been trained by the supplier on handling, maintenance, procedures for launch preparation, target selection, aiming and firing and, finally, real combat use of these systems.

168. Missiles and rockets were widely used during the Iran-Iraq war by both countries. Combat experience in the use of missiles and rockets during the war led Iraq to identify additional military requirements in the missile area that gave rise to several indigenous missile projects. Thus, during the initial phase of the Iran-Iraq war, Iraq identified the need for an additional tactical rocket system to fire at enemy targets within ranges from 30 km to about 50 km. Consequently, by the end of 1980, Iraq signed a contract with a foreign company on the joint development and production of a 262 mm 12-barrel rocket system, known as Ababil-50. Although Iraq received the technical documentation and necessary equipment for production of Ababil-50, it was unable to produce the systems indigenously. However, it received a number of Ababil-50 systems produced by the foreign partner.

169. The work on the Ababil-50 rocket system was an important step towards the development of Iraq's indigenous missile capabilities. Through the acquisition of this system and the active participation in its development and production, Iraq gained engineering experience necessary for other missile projects. It also obtained knowledge and machinery related specifically to double-base solid propellant missile technology.

170. During the Iran-Iraq war, SCUD missiles were launched against industrial and urban targets by both Iran and Iraq. However, while Iranian missiles were able to hit Baghdad, the range of SCUD missiles was not sufficient to reach Tehran and other targets in the depth of Iranian territory. This led Iraq to seek longer range foreign missile systems. However, Iraq's procurement efforts failed.

171. Iraq also initiated indigenous projects to develop a missile system with a range over 500 km. Thus, in 1984, Iraq signed a contract with a foreign supplier for the joint development and production of a missile system with an intended range initially of 620 km and ultimately 750 km. The project was known as BADR-2000. Under this project, the foreign supplier was responsible for deliveries to Iraq of a number of complete missiles and the materials, equipment and know-how for the production of the first-stage solid propellant motor in Iraq.

172. During the period 1985-1988, some of the manufacturing equipment was delivered to Iraq. At the end of 1987, Iraq commenced the construction of three facilities for the production of the first stage of the missile under the technical supervision of foreign suppliers. The first facility was constructed for the production of composite solid propellants. The second was built to manufacture the motor case

and other mechanical parts. The third was constructed for the final assembly and static tests of motors. According to Iraq, by the end of 1988 the foreign supplier had not delivered any actual missiles nor completed the delivery of production equipment and, further, was not likely to do so. Consequently, early in 1989, Iraq terminated its contract with this supplier and attempted to finalize the project related to indigenous production of the solid propellant first stage by contracting directly with various foreign companies to make good the deficiencies in equipment and technology transfer that were still required.

173. For that purpose, a new organization was set up in Iraq. It took over all three locations constructed under the BADR-2000 project that collectively had all the essential infrastructure and equipment for the production of composite solid propellant rocket motors: motor case production equipment, mixing, casting and curing facilities and static test stands. Raw materials were procured externally, although it was still intended to produce some of them indigenously. Prior to 1991, a part of the revamped project was to be dedicated to the development of a shorter range composite propellant missile. The project, however, had barely started prior to the 1991 Gulf war.

174. In 1986, a group of civilian and military experts was established by SOTI in coordination with the Iraqi Ministry of Defence to conduct a crash project to increase the SCUD-B missile's range to meet urgently the requirements for longer range missiles. The group included engineers who were previously involved in the development of the Ababil-50 rocket system. The group employed a relatively simple but aggressive modification concept involving the reduction of the missile payload, the increase of the propellant load capacity and the modification of the missile guidance and control system. The task was accomplished in an extremely short period of time, taking approximately one year before the modified missile named, Al Hussein, achieved a range of over 600 km.

175. Project 144 was then established to proceed with the mass modification of SCUD missiles into Al Hussein missiles and the indigenous production of Al Hussein missiles. Prior to 1986, Iraq had imported 441 SCUD missiles. Since the modification was based on the cannibalization of original foreign missiles, a large number of SCUD missiles were required for the ongoing conversion process. At the beginning, two to three SCUD missiles were needed in order to produce one Al Hussein. In addition, more than 50 SCUD missiles were consumed in static and flight tests during the development phase. Thus, to support the modification project, Iraq procured an additional 378 SCUD missiles from 1986 to 1988.

176. The modification of the SCUD-B missiles into the Al Hussein missiles was a large-scale project involving several establishments and factories. It also included the modification of imported mobile SCUD launchers to accommodate the longer Al Hussein missile in the first phase and the production of indigenously designed mobile launchers and development of indigenous control vehicles during the next phase. In parallel, several dozen fixed missile launchers were constructed in western Iraq.

177. The conversion of the SCUD-B missile into the extended range Al Hussein missile became possible after Iraq had achieved a certain entry level of technology that comprised basic engineering knowledge and elements of its indigenous military-industrial infrastructure. Iraq's experience in the conversion of the SCUD-B missile had proven that it is technically feasible for a country with basic

manufacturing capabilities to modify and extend the range of imported liquid propellant missiles. By their nature and design, the airframes of liquid propellant missiles can be modified, within limits, without affecting engine components. The propellant load can be increased and imported engine blocks and other critical parts can be used with indigenously produced sections of airframes. The increase in propellant load will be limited by the existing engine thrust and its take-off capacity; the missile payload, however, can be reduced to compensate for additional propellant. Thus, in the modification of the SCUD-B missile into the Al Hussein missile with its increased propellant load and reduced warhead, the original 300 km maximum range of the SCUD-B missile was doubled.

178. The conversion of the SCUD-B missile into the extended range Al Hussein missile was the most important achievement of Iraq's missile projects prior to 1991. The use of 189 Al Hussein missiles against Tehran and other urban targets in Iran within a short period of time, from February to April 1988, became known as the "war of the cities". Several salvo launches of Al Hussein missiles against Tehran had significant consequences, in particular in terms of morale. Although Iran used its own SCUD missiles against Baghdad, Iraq believed that the use of Al Hussein missiles in 1988 had a major impact on the outcome of the Iran-Iraq war, which ended in August that year.

B. Expansion of indigenous missile projects

179. The successful development of the Al Hussein missile, which marked growing self-confidence and elevated expectations regarding national missile capabilities on the part of the Iraqi leadership, opened a pathway to various subsequent indigenous missile projects that were based on the SCUD-B technology and undertaken by Iraq in the period 1988-1990. These comprised several versions of the Al Hussein missile and the Al Abbas, Al Tamooz and Al Abid missiles.

180. The Al Abbas project aimed at further extension in range of the Al Hussein missile up to 950 km, with a payload of up to 200 kg, in comparison to the 300 kg warhead of the Al Hussein missile. After several unsuccessful flight tests, it was determined that the missile should have a separating warhead. After further unsuccessful flight tests of the Al Abbas missile, a successful result of the separable warhead, on an Al Hussein missile, was finally achieved in June 1990. Al Tamooz, a more ambitious project, was to be a two-stage missile with the Al Hussein missile as the first stage and the liquid propellant sustainer section of the SA-2 surface-to-air missile as the second stage. The Al Tamooz missile was designed to carry a payload of 200 kg to a range of up to 2,000 km. The last project based on the SCUD technology was the Al Abid missile. It was intended to be a three-stage missile, designated as a space launcher, with clusters of Al Hussein missiles constituting its first stage and integrating the developments of the Al Abbas and Al Tamooz projects accordingly. The first experimental launch of the Al Abid space launch vehicle took place in December 1989, using mock-ups for the second and third stages. The initial launch phase was successful; however, the airframe exploded after 45 seconds.

181. These interlinked projects, with the exception of the Al Abbas missile, did not progress beyond basic design (Al Tamooz) or the development of a few prototypes and unsuccessful tests (Al Abid) before they were interrupted by the 1991 Gulf war. All were later terminated by Iraq as they were deemed proscribed activities under

Security Council resolution 687 (1991). However, the work on these projects allowed Iraq to expand further its engineering knowledge and missile development capability.

182. Another element of the expansion in Iraq's missile activities after the development of the Al Hussein missile was the foundation of a dedicated organization, Project 1728. This Project was created for the indigenous production of missile engines through the reverse engineering of SCUD missile parts. Project 1728 took over several parts of Project 144 and involved the construction of several new plants and factories and the acquisition of foreign equipment and materials. By 1989, the project was able to produce indigenously several parts of a SCUD liquid propellant engine. The first partially manufactured Iraqi SCUD engines comprised a combination of cannibalized, indigenously produced and imported parts. They were flight tested in 1990, although with limited success.

183. In the late 1980s, Iraq also commenced projects called Fahad 300 and Fahad 500 to modify SA-2 surface-to-air missiles to function in a surface-to-surface mode. In 1987, Iraq planned the construction of an entire production complex comprising several facilities to manufacture an SA-2 type missile. A contract on the transfer of technology with a foreign supplier was signed. Blueprints and technical documentation were received by Iraq. However, because of the large amount of money required by the foreign supplier, the technical difficulty of the programme and the fact that the system was already becoming outdated at that time, Iraq cancelled the contract in 1989. Nonetheless, Iraq continued with the indigenous Fahad 300 and Fahad 500 projects. During some 20 flight tests conducted by Iraq, the modified SA-2 missile achieved a maximum range of up to 270 km, but with insufficient in-flight stability and low accuracy. As a result, the mass conversion of SA-2 missiles to surface-to-surface missiles did not go ahead.

184. Among other pre-1991 indigenous missile projects were attempts to extend the range of the HY-2 and P-15 liquid propellant anti-ship cruise missiles. By increasing the propellant load and decreasing the warhead weight, Iraq was able to extend the original range of these cruise missiles but was not able to produce or acquire an appropriate guidance and control system due to the lack of critical components at that point in time. Thus, this project was also not finalized.

185. Work on missile guidance and control systems was an integral part of Iraq's indigenous missile projects. As a first step in the development of the Al Hussein missile, Iraq had to modify the timing unit of the SCUD missile in order to avoid the activation of a self destruct mechanism. When this step was successfully achieved, Iraq tried to procure additional sets of guidance and control systems, but these attempts failed. Iraq succeeded in the indigenous production of some guidance sections with the exception of the gyroscopes and accelerometers. Their development and production required specific knowledge that could not be acquired through reverse engineering of foreign components. Efforts were thus made to produce indigenously the guidance and control inertial systems by using components and materials that were reverse engineered by several foreign companies at the request of Iraq.

186. In general, despite the progress made by Projects 144 and 1728 prior to 1991, the technological level achieved was not sufficient for the indigenous production of critical missile parts, such as complete engines and key components of guidance and control systems. Further developments by those Projects were interrupted by the

1991 Gulf war. Iraq's activities to produce these parts were then prohibited by Security Council resolution 687 (1991).

187. Other pre-1991 missile activities conducted by Iraq included efforts to refurbish and, later, to produce indigenously different types of missile propellants for the SCUD, Al Hussein and SA-2 missiles in support of expanding missile activities. In pursuit of longer range delivery systems, Iraq commenced Project Babylon, an exotic project to develop a 1,000 mm calibre "supergun" to fire projectiles over hundreds of kilometres. A 350 mm calibre prototype gun had been completed and test fired before barrel parts for the large gun were seized by a foreign customs authority before delivery to Iraq, thus ending the Project.

C. The 1991 Gulf war and the adoption of Security Council resolution 687 (1991)

188. Most of Iraq's establishments, factories and plants involved in or supporting missile-related activities were destroyed or damaged by coalition aerial bombardment during the 1991 Gulf war. However, the major portion of the equipment used by various Iraqi missile projects was evacuated from these facilities prior to the attacks and did not suffer significant damage. The coalition bombing did not destroy any of Iraq's operational Al Hussein missiles or mobile launchers.

189. Pursuant to Security Council resolution 687 (1991), missiles remaining in Iraq that exceeded the 150 km range limit set by the Council, as well as their major parts, repair and production facilities were subject to destruction, removal or rendering harmless under international supervision. These covered the remaining SCUD-B and Al Hussein missiles, their mobile and fixed launchers and associated equipment and materials, such as launch control vehicles and equipment and missile fuels, as well as production equipment, tools, parts and materials used by Iraq for the development of missiles with a range greater than 150 km.

190. In 1991, under the terms of Council resolution 687 (1991), Iraq declared 48 missiles, 5 combat mobile launchers, 1 training launcher, 3 indigenous prototype launchers, a variety of launching and launch control equipment, fixed launch sites, over 70 tons of missile fuels and dozens of items of equipment for the production of composite solid propellant motors associated with the BADR-2000 project, as well as relevant sites and locations. All the declared assets were destroyed by Iraq under the supervision of United Nations inspectors. Several SA-2 missiles modified to a surface-to-surface role and parts of its supergun programme were also declared by Iraq and destroyed under international supervision.

191. However, in 1992, Iraq admitted that a major part of its Scud-type missile force including 85 missiles, 5 mobile launchers, equipment from 6 indigenous mobile launchers and over 500 tons of missile fuels, had not been declared in 1991. They were secretly destroyed by Iraq in contravention of its obligations under Council resolution 687 (1991). This unilateral destruction dramatically prolonged the verification process, led to the elimination of physical evidence required for credible verification, decreased confidence in Iraq's declarations and left a number of disarmament issues unresolved.

192. After the defection of Lieutenant-General Hussein Kamel from Iraq in 1995, Iraq admitted that it had concealed from the inspectors various elements of its

pre-1991 missile activities, including attempts by Project 1728 to produce indigenously missile engine parts and components. According to Iraq, items produced indigenously had been destroyed unilaterally in 1991, while various items of equipment used in their production had been retained. Subsequently, United Nations inspectors verified these retained items of equipment, comprising flow-forming machines, vacuum furnaces, a turbo pump test stand and balancing machines. Some items were ordered destroyed, while others were tagged and, in some cases, excluded from use in missile activities.

D. United Nations verification

193. Despite Iraq's attempts to conceal various aspects of its missile activities and its unilateral destruction of a significant number of proscribed missiles and associated equipment and materials, the inspectors were able to make progress in the disarmament verification.

194. Through extensive verification missions involving excavation and forensic evaluation of remnants of operational missiles destroyed unilaterally and the comparison of their serial numbers with those provided by the former supplier, it was possible to account for 817 of all 819 imported operational SCUD missiles as early as 1997. This is corroborated by the assessment made by the Iraq Survey Group in 2004 that only two missiles were not accounted for.

195. The history of United Nations verification in the missile area shows that United Nations assessments of Iraq's missile capabilities made on the basis of on-site inspections, evaluation of data collected in Iraq and data provided by the former suppliers were more accurate than other estimates.

196. The United Nations inspectors developed a good knowledge and understanding of Iraq's missile projects and activities. They found that Iraq's missile projects in terms of technology, equipment, parts and components relied heavily on foreign supplies and assistance. With these, however, Iraq was able to develop its indigenous knowledge and expertise, which resulted in the development and operational deployment of the Al Hussein missile in 1987 and the Al Samoud-2 and Al Fatah missiles in 2002.

197. The United Nations inspectors were able to supervise and make arrangements for the expeditious and safe destruction of proscribed missiles and associated equipment and materials. UNSCOM supervised the destruction of 48 missiles, 50 warheads, 5 combat mobile launchers, 1 training launcher, 3 prototype launchers, a variety of launching and launch control equipment, fixed launch sites, over 70 tons of missile fuel and several items of equipment.

198. The possession and development by Iraq of missile systems with ranges of less than 150 km were not prohibited by the Security Council but were subject to ongoing monitoring and verification based on the OMV Plan. Consequently, after 1991, Iraq retained capabilities to develop indigenously missiles with ranges close to 150 km. As a result, Iraq also had the capability to develop missiles that could exceed the prohibited range. However, it did not do so while under ongoing monitoring and verification.

E. Ongoing monitoring of missile activities in Iraq

199. The OMV Plan prohibited any unmanned delivery system capable of a range greater than 150 km regardless of payload and any related major parts. In addition, Iraq was obliged to declare all its missile systems that were designed for, or capable of being modified for a surface-to-surface role with a range greater than 50 km. After 1991, Iraq remained in possession of a number of missile systems and continued its work on the development of shorter range solid and liquid propellant missile systems.

200. While in the chemical and biological area any weapons-related activities were completely prohibited to Iraq, in the missile area Iraq was allowed to possess missiles, infrastructure, facilities, equipment and materials associated with missile systems within the permitted range, as well as to maintain respective teams of engineers and technicians. Included were foreign missile and rocket systems with a range below 150 km, such as the FROG-7, the SA-2, Ababil-50, and variants of anti-ship cruise missiles.

201. With respect to ongoing missile projects after 1991, Iraq pursued the development of indigenous solid and liquid propellant Ababil-100 missiles with a declared range below 150 km. The solid propellant development utilized know-how acquired by Iraq during its work on the BADR-2000 project, while the development of a liquid propellant missile was based on the use of the SA-2 missile engine.

202. Iraq formally accepted the provisions of the OMV Plan approved by Security Council resolution 715 (1991) only in 1993. Thereafter, UNSCOM established specific procedures for missile monitoring, including tagging of the Ababil-50, FROG-7, SA-2 and anti-ship cruise missiles that remained in large numbers in Iraq. Iraq's facilities involved in the development of indigenous missiles within the permitted range were also placed under monitoring that included regular declarations by Iraq, on-site inspections, static and flight test observation, use of remote cameras, and tagging of key manufacturing equipment that could be used for the production of missile parts and components, such as vacuum furnaces and flow-forming machines.

203. It was understood by the inspectors in the course of monitoring that the assessment of the range capability of a missile that is fully developed (with a known standard payload) can be made on the basis of technical documentation and flight tests. However, the assessment of the maximum range capability of a missile system under development was more complicated. The results of flight tests of missiles under development could depend on multiple parameters, such as fuel load, payload and engine shut-off (burn time), that could be changed at a later stage and thus could affect the range. Therefore, a range value alone is insufficient as a criterion upon which to limit development activities when monitoring a missile under development. Additional technical parameters that could be practicably verified with a minimal degree of ambiguity were applied in the course of ongoing monitoring and verification and have proven to be effective tools that deterred Iraq from developing proscribed missiles while under United Nations inspection.

204. Thus, in 1994, in the monitoring of Iraq's development of the Ababil-100 liquid engine missile, UNSCOM introduced additional restrictions. These included a 600-millimetre limit for the diameter of the airframe and the prohibition of any modifications of SA-2 missiles relevant to their conversion into a surface-to-surface

mode. Additionally, in 1997, after the evaluation of the first prototype of the Al Samoud-1 missile, which was based on Iraq's previous work on the liquid propellant version of the Ababil-100 missile, UNSCOM completely prohibited the use of original or modified SA-2 components in any surface-to-surface missile programme. While Iraq did not formally accept these restrictions, it refrained from the production of missile systems that would violate them until December 1998, when United Nations inspectors were withdrawn from Iraq.

205. These additional restrictions were also introduced by UNSCOM, taking into consideration the admission made by Iraq after the defection of Lieutenant-General Hussein Kamel, that in 1992-1993, Iraq had concealed from inspectors two indigenous missile projects, the G-1 and Al Rafidain, both aimed at developing a surface-to-surface missile based on the SA-2 missile.

206. Remotely piloted vehicles (RPV) and unmanned aerial vehicles (UAV) were also covered by the provisions of the OMV Plan with regard to the prohibition of delivery systems capable of a range greater than 150 km regardless of payload. After 1991, Iraq continued several remotely piloted and unmanned aerial vehicle projects and the development of several smaller drones for air defence training. In June 1997, Iraq declared that in November 1995 it had started an aircraft conversion project involving the conversion of L-29 training aircraft into RPVs for air defence training. According to Iraq's declarations, the L-29 RPV was designed to fly to a range of about 80 km, which was itself determined by the effective limits of the remote control station on the ground.

207. The record of ongoing monitoring and verification in the missile area shows that monitoring goals could be achieved through a verification system comprising regular declarations by Iraq, on-site inspections, static and flight test observation, the use of remote cameras, inventory of relevant equipment and tools, document and computer searches and tagging of missile hardware, in combination with an export/import monitoring mechanism and restrictions on the reuse of missile parts and components from other missiles within the permitted range.

F. Hiatus and resumption of missile monitoring and verification activities

208. In the absence of United Nations inspectors in the period from 1999 to 2002, violations of restrictions on the use of SA-2 missile parts occurred, together with the illicit procurement of critical foreign missile parts and components. This, combined with the knowledge and experience accumulated in the course of past missile projects, allowed Iraq to make a breakthrough in the missile area, developing two new indigenous missiles, Al Samoud-2 and Al Fatah, in a relatively short period of time.

1. Al Samoud-2 missile

209. The development of the Al Samoud-2 missile was started by Iraq in 2001 in the absence of international inspectors. It was a continuation of earlier projects carried out from 1992, such as the liquid propellant version of the Ababil-100 missile, later developed into the Al Samoud-1 missile, and previous attempts to reverse engineer the SA-2 missile and its components. These earlier projects had not

been finalized owing to the restrictions imposed on the use of SA-2 parts and components and the intrusive monitoring of the facilities and hardware involved.

210. The Al Samoud-2 missile has a 760 mm diameter airframe produced indigenously. It also has a SA-2 liquid propellant engine, modified with a solid propellant gas generator starter and a shut-off system. Its guidance and control system, by its conceptual design, was similar to the SCUD guidance system but was built mainly with SA-2 parts, including gyroscopes, battery, actuators, air bottles and air reducers. Its warhead and fuzing system were produced indigenously. A total of 97 Al Samoud-2 missiles, 112 warheads, 9 launchers and 9 command vehicles were declared to have been produced by Iraq prior to the determination by UNMOVIC in February 2003 that the Al Samoud-2 was a proscribed missile system.

211. The declared ranges achieved by the Al Samoud-2 missile during developmental flight tests were in the vicinity of the 150 km range limit, although on a number of occasions they exceeded the limit. Thus, expert evaluation and judgement was required to assess its range capability since results of flight tests can depend on particular environmental conditions and different test parameters. On the basis of the assessment of an international panel of experts that the missile was capable of exceeding the permitted range, UNMOVIC determined the Al Samoud-2 missile to be a proscribed missile under resolution 687 (1991) and designated it for destruction.

212. Prior to its withdrawal from Iraq in March 2003, UNMOVIC had supervised the destruction of 72 Al Samoud-2 missiles, 74 warheads, 3 launchers and 3 command vehicles and 5 liquid propellant engines, as well as the production equipment in 3 factories out of 5 involved in the Al Samoud-2 production. Remaining Al Samoud-2 associated items to be destroyed included 25 missiles, 38 warheads and 326 engines.

2. Al Fatah missile

213. Iraq began the development of the Al Fatah missile in 1999, shortly after the withdrawal of United Nations inspectors from Iraq. The work was based on Iraq's previous development of a solid propellant version of the Ababil-100 missile. The Al Fatah was designed as a 500 mm diameter, composite propellant missile containing some 800 kg of solid propellant, with a warhead of approximately 300 kg and an intended range of 145 km. Iraq indigenously produced several propellant mixers and casting chambers for filling Al Fatah motors, and repaired two casting chambers that had been procured by Iraq under the BADR-2000 project and had been later partially destroyed under UNSCOM supervision in 1991.

214. Iraq conducted more than 30 flight tests of the Al Fatah missiles. In several tests the missile range exceeded 150 km. However, a suitable guidance and control system remained Iraq's major problem in the development of the Al Fatah missile. Iraq tried two different approaches to develop such a system, first using foreign procured components and secondly using parts manufactured indigenously in combination with components of the SA-2 guidance system. This part of the work was not finalized. Nevertheless, 37 Al Fatah missiles were said to have been deployed to the army without guidance and control systems. According to the Iraq Survey Group report, more than a dozen Al Fatah rockets were fired against the coalition in 2003.

215. A decision by UNMOVIC as to whether the Al Fatah missile constituted a proscribed system was pending in March 2003, awaiting additional information requested from Iraq on this missile. The Iraq Survey Group, in their comprehensive report of September 2004, assessed that the Al Fatah was a proscribed system. The two casting chambers refurbished by Iraq were, however, destroyed by Iraq under the supervision of UNMOVIC inspectors prior to their withdrawal from Iraq in March 2003.

3. Other missile activities carried out by Iraq in the absence of inspectors

216. Iraq declared that in the period from 1999 to 2002, it had resumed efforts to modify the HY-2 missile. The original HY-2 engine was replaced by the engine of a C-611 air-launched anti-ship cruise missile, also available in Iraq. The guidance and control system of the modified HY-2 missile was improved using foreign procured parts and components. Two flight tests of modified missiles were performed. During one test, a range of 150 km was declared.

217. In 2002 Iraq also declared to UNMOVIC that it had started a new RPV/UAV project in May 1999, the RPV-20, aimed at the design and construction of a programmable drone with a flight range of 100 km and endurance of one hour. Other projects, including the RPV-30, commenced after 2000, but the RPV-20 was the only RPV/UAV in series production. It was tested several times using an onboard global positioning system (GPS) to fly in circuits. In order to fly beyond visual range, that is, beyond the limit of radio-telemetry control, an RPV requires an autonomous navigation and flight control mechanism (thus becoming a UAV). The information available to UNMOVIC suggests that the concept of these RPV/UAVs was for conventional military purposes such as air defence training, data collection and surveillance. UNMOVIC found no evidence that Iraq's RPV/UAV systems had achieved prohibited ranges.

218. The review of Iraq's missile projects suggests that for a country already possessing liquid propellant missiles, those missiles are the most likely candidates for modification aimed at range extension, which can be achieved through payload reduction and an increase in propellant capacity. This can be illustrated by Iraq's conversion of the SCUD-B missile into the extended range Al Hussein missile and the range extension project for the HY-2. Parts and components of liquid propellant surface-to-air missiles can also be easily used in the production of a surface-to-surface missile, like the liquid propellant engine of the SA-2 missile which was used for the prohibited Al Samoud-2 missile.

219. On the other hand, the example of Iraq's development of the Al Fatah missile demonstrates that in undertaking the development of a new indigenous missile, a solid propellant missile may be a more likely choice. This is because a solid propellant missile is intrinsically simpler in construction than a liquid propellant missile. Although the successful production of both solid and liquid propellant missiles is technically challenging, a liquid propellant engine comprises a larger number and variety of parts, some of which require an advanced level of technology for their manufacture. Iraq was not able to produce indigenously entire liquid propellant engines.

220. However, overall, examples of both liquid and solid propellant missile projects show that mastery of guidance and control development is critical for the successful production of any missile system. While Iraq was capable of producing some

elements of guidance systems, it did not reach a technological level sufficient to produce indigenously critical elements such as gyroscopes and accelerometers and had to rely instead on the procurement of foreign parts. Thus, controls over exports of these components or complete sets of guidance and control systems are essential for the non-proliferation of missile technology.

221. The monitoring experience also showed that if a missile's range is somewhere in the vicinity of the permitted value, then expert evaluation and judgement are required to determine if the missile will exceed range limits since the results of flight tests will depend on particular environmental and test conditions. Such was the case when UNMOVIC determined the Al Samoud-2 to be a proscribed missile.

222. The evaluation and comprehension of all aspects of Iraq's past missile projects has proved to be a major prerequisite for the development of an effective monitoring system because Iraq's later missile developments were based on experience gained from previous missile projects.

VI. Iraq's biological weapons programme

A. Development of the biological weapons programme

223. The biological weapons programme of Iraq was much smaller in size and scale than the chemical weapons programme and various missile projects. The programme, which was the last started among Iraq's efforts in the field of weapons of mass destruction, materialized after Iraq had already developed and deployed its chemical weapons and progressed in the modification of foreign missile systems. However, the programme was the most covert undertaken of all the non-conventional weapons programmes in Iraq.

224. Although the biological work was initiated by Iraq in the 1970s, at that stage it was focused on general research into the basic parameters and characteristics of different micro-organisms but, in general, not exclusively those traditionally associated with biological warfare. As part of the programme, Iraq constructed a dedicated research facility, the Ibn Sina Centre, located on the Salman peninsula near the town of Salman Pak, some 30 km south-east of Baghdad. The Ibn Sina Centre came under the auspices of a newly created organization, Al-Hazen ibn al-Haitham Institute, which was in turn subordinated to the special security and intelligence agencies. However, this first attempt to establish a biological weapons programme in Iraq came to a halt in 1978, when the Institute was shut down by the Government for the stated reason of having achieved poor results.

225. There is no evidence available to UNMOVIC whether any work in connection with biological warfare was conducted immediately following the closure of Al-Hazen ibn al-Haitham Institute. From Iraq's declarations and interviews with Iraqi scientists, however, it is clear that some biological activities continued at Salman Pak under the auspices of the security apparatus. At the end of 1984, such activities included research on wheat smut, with a view to finding suitable measures for crop protection and investigating this agent as a possible weapon that would cause economic loss.

226. Military interest in the development of the biological weapons programme was first expressed by the head of Iraq's chemical weapons programme in 1983.

However, no immediate practical actions were taken until 1985, when a small biological group was formed at Iraq's prime chemical weapons complex near Samarra (later also known as the Muthanna State Establishment, some 100 km north-west of Baghdad). Late in 1985, bacterial strains, basic laboratory equipment, pilot-scale production equipment and materials were procured from foreign suppliers. Two agents, botulinum toxin and *Bacillus anthracis* (the causative agent of the disease, anthrax), were selected as candidate biological warfare agents. The work was focused on pathogenicity and toxicity studies, characteristics of agents and methods for their production at the laboratory scale. For its work the group used the existing infrastructure of the chemical complex, including several laboratories, an inhalation chamber and an animal house.

227. By the end of 1986, the biological work at Muthanna was scaled up with the intention to produce botulinum toxin at pilot scale and a proposal was made to affiliate the single-cell protein facility at Al-Taji (some 20 km north of Baghdad) to the biological weapons programme. In 1987, Iraq's chemical weapons programme personnel considered further expansion of biological activities at the Muthanna complex to be incompatible with the other site activities and infrastructure. Consequently, the biological weapons group was transferred to the Forensic Research Department of the Technical Research Centre at Salman Pak in mid-1987. Lieutenant-General Hussein Kamel was at that time the head of Iraq's special security apparatus, and since the Research Centre was established as a technical branch of the intelligence and security service, it was also directly controlled by him. Later, when Hussein Kamel became the director of the Military Industrialization Commission, the Technical Research Centre was transferred to that Commission and remained under his direct control and supervision.

228. The biological weapons programme was expanded significantly after its transfer to the Technical Research Centre. The single-cell protein facility at Al-Taji was acquired, more laboratory equipment and materials were procured and additional personnel were recruited. Construction was started on a new building at Salman Pak to house a pilot-scale fermenter. Production of botulinum toxin and anthrax began with the use of bench-top fermenters, and experimentation commenced using a range of animals to study inhalation and other exposure routes and effects.

229. At the end of 1987, the scope of the biological weapons work was further expanded and research into additional bacterial agents, such as *Clostridium perfringens* and fungal toxins, such as trichothecene mycotoxins, was carried out. In 1988, Iraq also began to produce botulinum toxin at a refurbished fermentation unit at the single-cell protein facility at Al-Taji. Early in 1988, Iraq also began field trials on the dissemination of biological warfare agents. These trials involved munitions supplied by the Iraqi chemical weapons programme and an aerosol spray device modified specifically for the biological weapons programme. Following a successful although hurried research and development programme and basic pilot-scale production, the biological weapons programme moved towards large-scale production which required the construction of a dedicated facility for this purpose. Salman Pak was considered to be an unsuitable site for large-scale production, on the grounds of safety considerations, because of its proximity to Baghdad.

230. Iraq's main biological warfare agent production facility, Al Hakam, was built at a remote desert location (60 km south-west of Baghdad) in remarkably short time,

during the period from March to December 1988. It would appear that Iraq, while developing Al Hakam, had also drawn important lessons from its previous weapons projects, especially the functioning of its chemical weapons complex at the Samarra site, which had been largely designed and constructed by foreign companies with the presence of their contractors on the ground. This resulted in the exposure of the true nature of that site and further led to the introduction of international trade regulations that impacted the chemical weapons programme. In contrast, Al Hakam was built in full secrecy without the involvement of any foreign companies or contractors. Information regarding its physical location, purpose and affiliation to the Technical Research Centre was strictly classified. Even contracts for the acquisition of relevant equipment and materials for Al Hakam were issued under the cover of other Iraqi organizations and agencies. Because of this secrecy, Al Hakam was not identified as a biological weapons facility prior to the 1991 Gulf war and subsequently was not subject to aerial bombardment by the coalition. Large-scale fermentation equipment for Al Hakam was sought from foreign suppliers in 1988. Nevertheless, procurement attempts failed since prospective suppliers were not able to obtain export licenses from their national authorities. Attempts to acquire specific spray dryers also failed for the same reason. A line of fermenters and support equipment from the Veterinary Research Laboratories (later known as Al Kindi Company for the Production of Veterinary Vaccines and Drugs) at Abu Ghraib (15 km west of Baghdad) was transferred to Al Hakam, as well as equipment from the single-cell protein facility at Al-Taji.

231. Early in 1989, the production of botulinum toxin was started at Al Hakam, while pilot-scale production of anthrax and aflatoxin began at Salman Pak. The production of anthrax at Al Hakam started later, in 1990. Research included laboratory-scale experiments related to the drying of anthrax. However, according to Iraq, since special dryers could not be obtained, this work did not progress. The biological weapons programme also began research on other agents and toxins, including ricin toxin and *Clostridium botulinum* spores.

232. After the invasion of Kuwait by Iraq in August 1990, Iraq increased the production of bulk biological warfare agents and began to weaponize them. To increase the production of bulk warfare agents, the Technical Research Centre acquired two additional commercial facilities, the foot-and-mouth disease vaccine plant at Al Dawrah (in the south-west suburbs of Baghdad) and the agricultural research and water resources centre (known as Al Fudaliyah, some 15 km north-east of Baghdad).

233. Unlike Al Hakam, which was built as a dedicated biological warfare facility, the plant at Al Dawrah was constructed as a legitimate turnkey facility by a foreign company in the late 1970s and early 1980s. The plant was designed for the production of vaccine for foot-and-mouth disease, which is endemic in Iraq. When the facility was utilized for the production of botulinum toxin in 1990, the production of vaccine was suspended. Several partitions were installed to separate the zone established for biological weapons production from the area of the vaccine production. The plant was also used, after its acquisition by the biological weapons programme, for research on three viruses — camelpox, enterovirus 70 and human rotavirus. Al Fudaliyah was a legitimate civilian facility that was used for the production of the biological warfare agent aflatoxin without any significant modifications to its infrastructure.

B. The 1991 Gulf war and United Nations verification

234. Of the five Technical Research Centre sites involved in the Iraqi biological weapons programme, only the facilities at Salman Pak were targeted by the coalition forces during the 1991 Gulf war. In addition, there were military strikes on other suspected sites, including the Abu Ghraib baby milk factory and Al Kindi Company. Buildings and infrastructure of the Technical Research Centre's forensic department at Salman Pak used by the biological weapons programme were heavily damaged by the aerial bombardment while other facilities, such as Al Hakam, the foot-and-mouth disease vaccine plant at Al Dawrah and Al Fudaliyah, were not targeted and therefore sustained no damage.

235. After the adoption of Security Council resolution 687 (1991), in April 1991, Iraq declared that it had no biological weapons programme. In May that year, Iraq identified a number of biological facilities that worked with micro-organisms or contained fermentation equipment, including the four facilities admitted later in 1995 to have been used in the offensive biological weapons programme.

236. Prior to the arrival of the first United Nations biological inspection team, Iraq cleaned all sites involved in the production of biological warfare agents, removed evidence of past activities, including relevant documents and records, reconfigured equipment, decontaminated and renovated buildings and structures and prepared cover stories.

237. In August 1991, Iraq informed United Nations inspectors that one of the declared facilities, Salman Pak, had been involved in a biological military research programme and reported that it had obtained 103 vials of bacterial reference strains from foreign suppliers; it provided details on the individual types, source, year of importation and quantities. Of the 103 imported vials, 13 were stated by Iraq to have been used, while 90 were handed over to the United Nations inspectors unopened.

238. From the beginning of its verification activities in Iraq, the United Nations undertook inspections to identify a variety of sites and facilities referred to it by Member States as allegedly having been involved in the Iraqi biological weapons programme. Some of the sites were not declared by Iraq, and included facilities with possible underground structures. However, no facilities inspected on the basis of such information were found to have been involved in the biological weapons programme. Al Hakam, the foot-and-mouth disease vaccine plant and Al Fudaliyah were not among suspected sites referred to the inspectors through intelligence information.

239. In May 1991, Iraq first identified Al Hakam as a legitimate biological facility intended for the future production of vaccines or other materials produced by micro-organisms such as single-cell proteins. The facility was inspected for the first time in September 1991. Several samples taken by the inspectors from different pieces of equipment at Al Hakam were analysed by one outside national laboratory and were reported to be negative for the presence of biological warfare agents.

240. In their inspection report of September 1991, the inspectors raised concerns regarding the true nature of Al Hakam and noticed several unusual features of the facility. They included the presence of multiple air-defence units around its perimeter, enhanced protection and bunker-style structures, the distant separation of different areas within the facility, the rapid construction of the site implying a strong

sense of urgency, its isolation and secrecy, the presence of equipment that had been transferred from other sites, and the weak economic rationale for the purported production of single-cell protein and biopesticide. Limited scope inspections at specific locations within Al Hakam were carried out, once each in 1992 and 1993, before regular monitoring activities began at the site in 1994.

241. Although the inspectors believed that the facility could have been planned as the next stage in Iraq's biological warfare programme, no evidence of its involvement in biological warfare activities was found during that period. It was assumed that the very low level of biological containment in the facility prevented it from being used for the production of dangerous pathogens and that its equipment was not suitable.

242. With regard to the foot-and-mouth disease vaccine plant at Al Dawrah, the inspectors, who visited the plant from September 1991 to 1995, identified the site capabilities for the production of biological warfare agents, but concluded that the site was a legitimate facility since no modification to its original design had been observed. No indication of its involvement in Iraq's biological warfare programme arose until Iraq declared in August 1995 its past involvement. Since extensive sampling of equipment at this facility had not been performed prior to 1995, the evidence of its involvement was not uncovered prior to Iraq's declaration. The inspectors were also not aware of the involvement of Al Fudaliyah in Iraq's biological weapons programme, and they did not conduct sampling and analysis during their inspections of that site.

243. By 1995, the inspectors had collected sufficient evidence to suggest that Iraq's biological warfare programme was not limited to research activities, but had also included the production of bulk quantities of several biological warfare agents and, possibly, their weaponization. Consequently, in July 1995, under pressure from United Nations inspectors who had been investigating, inter alia, the material balance of imported growth media, Iraq finally admitted the past bulk production of biological warfare agents at Al Hakam.

244. After the defection of Hussein Kamel from Iraq in August 1995 and the subsequent revelation of the "chicken farm" material, Iraq further admitted that biological warfare agents had also been produced at two other civilian facilities, the foot-and-mouth disease vaccine plant at Al Dawrah and Al Fudaliyah. Iraq also declared that it had weaponized bulk agents but had unilaterally destroyed all bulk agents and biological weapons in 1991. The weapons included 25 special warheads for Al Hussein missiles and 157 R-400 aerial bombs, filled with biological warfare agents. With respect to weaponization, Iraq declared that warheads for Al Hussein missiles and R-400 aerial bombs had been filled with liquid biological warfare agents. Iraq also provided information on other types of aerial and artillery munitions used in field trials with biological warfare agents or simulants.

245. In 1996, the entire Al Hakam complex, including all buildings, support infrastructures, utilities, equipment and materials, was destroyed by Iraq under United Nations supervision, as well as equipment and materials used by Iraq for biological warfare purposes and remaining at Salman Pak, Al Fudaliyah and the plant at Al Dawrah. In addition, the air-handling system of the vaccine plant at Al Dawrah was permanently disabled.

246. The remnants of biological munitions which Iraq declared had been filled with *Bacillus anthracis*, botulinum toxin and aflatoxin were provided to the inspectors for verification. In addition, Iraq provided the locations where the unilateral destruction of bulk agents, including *Bacillus anthracis*, botulinum toxin, *Clostridium perfringens* and aflatoxin, had taken place. These included two dump sites at Al Hakam and destruction sites at Al Azzizziyah firing range (75 km south-east of Baghdad) and Al Nibai desert (50 km north-west of Baghdad).

247. In 1996, United Nations inspectors took samples from Al Hakam disposal and dump sites. Analysis of those samples indicated that certain areas of the site did contain elevated levels of *Bacillus anthracis* spores. In addition, sampling and analysis of the fragments of biological munitions destroyed unilaterally by Iraq revealed the presence of DNA fragments of *Bacillus anthracis* and *Clostridium botulinum*. However, owing to the extent of the destruction carried out by Iraq and the lack of records relating to those activities, it was not possible to quantify fully all aspects of Iraq's account of its unilateral destruction, including quantities of bulk agents and numbers of munitions.

248. It should be noted that fragments of destroyed biological munitions were first inspected, but not recognized as such, by inspectors in 1992, when these had been claimed by Iraq as part of the chemical munitions. However, no samples of those fragments were taken for analysis until after Iraq admitted to the weaponization of biological warfare agents. In addition, dozens of empty R-400 bombs produced for biological warfare purposes had been destroyed under the supervision of United Nations chemical weapons inspectors as early as October 1991. At that time, the inspectors had not fully understood or appreciated the specific features and markings, black stripes, and the different internal coating found in some of the bombs.

249. With regard to Al Hussein missile warheads filled with biological warfare agents and later unilaterally destroyed by Iraq, in 1992 inspectors verified the number of fragments which Iraq declared to have been from chemical warheads. Since there were no distinctive physical differences between chemical and biological warheads and inspectors were still unaware of any biological weaponization, the true nature of those warhead fragments was not investigated further. Following Iraq's admission in 1995 of the weaponization of Al Hussein warheads with biological warfare agents and their later unilateral destruction in 1991, inspectors sampled warhead fragments and obtained samples found to be positive for the DNA of *Bacillus anthracis*.

250. In order to account for the 157 declared R-400 biological bombs said to have been filled with various biological warfare agents, Iraq began a re-excavation programme at Al Azzizziyah firing range in February 2003. Iraq unearthed and UNMOVIC verified remnants which included eight intact bombs and various bomb components, such as base plates, tails and nose cones, that accounted for 104 bombs. UNSCOM had previously verified 24 bombs at the site. Therefore, United Nations inspectors had verified 128 bombs out of the 157 declared as having been destroyed there unilaterally. The remaining, unaccounted-for bombs were stated to be located at the airfield and in a state similar to that of the other bombs found. While Iraq continued excavation in search of further remnants of the bombs, none were found by the time the inspectors were withdrawn from Iraq in March 2003. It has been assessed by UNMOVIC on the basis of sampling results from other bombs

that, even if the bombs had remained intact, any biological agent they might have contained would have degraded and would no longer be viable.

251. In 1995, Iraq declared two projects carried out in 1990 to investigate the modification of a MiG-21 fighter aircraft into an unmanned aerial vehicle and the conversion of a Mirage F-1 drop tank for the dissemination of biological warfare agents. United Nations inspectors found no evidence that those two projects were continued after 1991. Iraq also declared the development by the Technical Research Centre of smaller remotely piloted aerial vehicles in the late 1980s. Of concern to United Nations inspectors was the association between the organizations that managed and supported remotely piloted and unmanned aerial vehicle programmes and those formerly involved in Iraqi biological weapons programmes.

252. While there was some concern on the part of United Nations inspectors that the L-29 project (mentioned earlier) could have been a follow-on to the MiG-21 unmanned aerial vehicle project, no evidence linking the L-29 with the chemical and biological weapons programme was found. Information gathered by the inspectors suggested that the purpose of the smaller, more recent projects post-1998 (for example, the RPV-20) was related to conventional military applications such as air defence training, data collection and surveillance. No evidence was found that Iraq had developed these systems for the delivery of biological warfare agents.

253. With regard to agent production, United Nations inspectors had concerns that more bulk agents might have been produced than declared by Iraq and that the bulk agents might not have been destroyed as declared. If anthrax spores were preserved and stored in optimal conditions, they could have been viable for many years, leaving the possibility that, with improvements in Iraq's spray-drying capabilities after 1992, the bulk agents could have been dried. UNMOVIC found no evidence to suggest that bulk agents were stored in a manner other than declared. While some evidence suggested the possibility of more production than declared, it would appear that all bulk agents were destroyed in 1991. No evidence was obtained by the United Nations inspectors that Iraq had spray-dried agents in bulk. The United States-led Iraq Survey Group, in searching for Iraqi weapons of mass destruction, had made similar findings, with the addition of statements by Iraqi scientists on the destruction of anthrax near a presidential palace at Radwaniyah in Baghdad, in 1991.

254. The inspectors also ensured that facilities, equipment and materials known to have been used by Iraq in the past for its biological weapons programme were destroyed or rendered harmless under United Nations supervision. United Nations monitoring and verification of Iraqi biological activities found no evidence that proscribed biological warfare activities had been resumed after 1991. United Nations inspections combined with sanctions may have been a deterrent to Iraq in continuing its biological weapons programme.

255. Verification in the biological area is inherently more complex than in the chemical or missile areas, where concern is focused mainly on the destruction of weapons, bulk agents and precursors, or missile systems or components. However, in the biological area the concept of verification also includes the fact that biological agents are self-replicating and that large amounts of bulk agents can be produced from a single vial of seed stock. Therefore, the confidence in the total verification process depends to a large extent on accounting for reference strains and seed stocks of micro-organisms.

256. United Nations inspectors were able to verify parts of the declarations with respect to Iraq's use of and subsequent destruction of master and working seed stocks. However, they had noted that accounting for all seed stock obtained from open vials would be virtually impossible, as it could have been widely distributed as secondary seed stock throughout Iraq. As a consequence, the issue remains part of the residue of uncertainty with respect to the continued existence in Iraq of secondary seed stocks that could possibly be used in the future for the production of biological warfare agents. In addition, in the biological area all production equipment and materials are inherently dual-use and therefore there are no unique features or markers which point unambiguously to proscribed activities. These issues could best be dealt with through monitoring to detect, inter alia, any possible future activity associated with the production of agents for biological weapons or significant related laboratory research work. In contrast, in the missile and chemical areas, some precursor chemicals or missile components or types of equipment are clearly used only for proscribed purposes.

257. From the adoption of Security Council resolution 687 (1991) in April 1991 until the commencement of biological inspections in August 1991, Iraq had time to eliminate much of the evidence of past activities at facilities used in its biological weapons programme. Thus, prompt commencement of inspection and verification activities at newly declared or identified facilities is essential, especially for biological inspections. The availability of qualified and trained inspectors for deployment at short notice and well-established sampling and analysis capabilities and procedures, both within the inspection team and in outside laboratories, are required.

258. Diversified expertise within the inspection teams is needed, comprising not only trained experts in the biological warfare field but also specialists in scientific and technical areas relevant to specific activities such as those declared by Iraq at Al Hakam. Expertise in an area such as the production of single-cell protein would be required to ascertain whether a facility like Al Hakam fits its declared status and purpose by its design, construction, equipment, staffing and budget.

259. Additional experience gained by the United Nations relates to sampling and analysis, which carries the notion of scientific argument and thus has a strong influence on a final assessment. Results of sampling, however, need careful analysis as both false positive and false negative results can occur. In addition, a limited sampling strategy risks missing relevant information and may even be counterproductive. An adequate sampling policy comprising environmental, background and investigation-related points at facilities used by Iraq for its biological weapons programme could have enhanced the chances of detecting proscribed materials at an earlier stage. Likewise, the use of more than one reference laboratory for analysis reinforces confidence in the results obtained.

260. To be effective, sampling and analysis require sufficient preparation, trained inspectors and the constant updating of analytical procedures. Even the results of extensive sampling and analysis may be limited, owing to the technical limitations of the analytical methods available and used at a given time. In view of the rapid developments in biotechnology and in particular the associated diagnostic and analytical techniques, it is desirable to keep samples for a sufficient period of time in case new, more sensitive methods of analysis are developed.

261. Considerations related to the low level of biological containment were major factors in the initial perception of the unsuitability of Iraq's dedicated biological weapons production facilities for the production of pathogens. These considerations were drawn from microbiological and manufacturing practices and advanced standards familiar to inspectors who were experts on biological weapons.

262. The assumptions regarding the unsuitability of Iraq's dedicated biological weapons production facilities were reinforced by the lack of evidence at the time that Iraq had progressed beyond research and development of biological warfare agents. In the absence of such conclusive evidence, it was difficult to assess that Al Hakam was a biological weapons production facility or that Iraq had produced bulk agents or had biological weapons, until 1995. As was subsequently explained by Iraq, it had produced liquid bacterial biological warfare agents accepting a moderate risk of airborne contamination.

263. United Nations inspectors found no evidence that Iraq produced dry bacterial warfare agents. Forensic sampling and analysis of spray-drying equipment present at Al Hakam in 1996 revealed no traces of biological warfare agents. The spray dryers at Al Hakam lacked the required biological safety containment features, which Iraqi scientists recognized as a necessary condition for their own protection. In addition, no evidence of biological munitions filled with dry agents was found. However, since all biological munitions were destroyed unilaterally by Iraq without United Nations supervision, it was not possible to determine whether weaponized biological warfare agents had been in liquid or dry state. This did not ease inspectors concerns on the level of Iraq's achievements until, in 1997, three bombs filled with liquid and chemically inactivated botulinum toxin were unearthed from the destruction site declared by Iraq and sampled. In addition, in 2003, bombs filled with chemically inactivated *Bacillus anthracis* in liquid form were also excavated and sampled. Thus, the positive verification of two liquid biological warfare agents found in munitions reduced the concern that Iraq had produced dry agent.

264. In the absence of sampling and analysis, finding the evidence to uncover Iraq's biological weapons programme was difficult. In particular, the detection of the conversion of a legitimate biological facility for biological warfare purposes turned out to be especially difficult since such activities had taken place only for a short period of time, and the site required only minor adjustments for the production of a biological warfare agent. While modern analytical and detection techniques have advanced significantly in recent years, so too have advancements in technology which could make detection much more difficult, such as "clean-in-place" capabilities and disposable production systems, thus presenting new challenges for the future.

265. Since Iraq did not deploy any weapons systems specifically designed for the dissemination of biological aerosols, and initially did not declare the existence of any biological weapons, United Nations inspectors were not aware of nor did they identify the R-400A bombs as biological delivery munitions. The inspectors accepted Iraqi statements that the empty bombs present at the Muthanna State Establishment were part of the chemical weapons arsenal, since those munitions were mainly adapted from the chemical weapons programme located there and because of their design and construction, they were not capable of efficiently disseminating biological aerosols. Thus, those weapons were not identified as being biological munitions by the inspectors who first observed them in 1991. With regard

to specific munitions and devices, a thorough evaluation of all weapons which could be adapted for biological warfare purposes is required to identify possible biological munitions through their specific features and signs, such as internal coating and unexplained markings.

266. If a deception campaign is actively pursued, the probability of finding hard evidence of activities related to biological warfare is minimized. An important technical tool that could have helped to identify such facilities is extensive "forensic" sampling and analysis. Iraq was well aware of the possibility of inspectors taking samples and tried to remove any traces of the agent by thorough decontamination of the facilities. In the future, it is possible that it may be even more difficult to obtain evidence through sampling despite improvements in detection and analysis. Experience of the United Nations inspectors clearly demonstrates that inspectors should not confine themselves to sampling evidence alone. If information exists, it may also be gleaned through secondary sources or an amalgam of interviews, searches of financial records, documents, procurement records, or by examining personal associations and hierarchical structures.

267. The account of the United Nations verification indicates that, under a comprehensive and intrusive international inspection regime, Iraq could not completely hide its biological weapons programme. Although it has not been possible to answer satisfactorily all outstanding questions concerning Iraq's biological weapons programme, such as total quantities of bulk agents produced, weaponized and destroyed, the inspectors were able to discover evidence of a programme larger than had been declared by Iraq. United Nations inspectors were also able to develop effective lines of investigation that led Iraq eventually to admit the bulk production of biological warfare agents.

VII. The compendium

268. The summary has been presented in deliberately general terms while specific technical details are contained in the five volume, 1,500 page full compendium. The specific details include sensitive information related to technology, research and products, names of foreign companies, institutions and banks, names of countries and names of individuals.

269. All information resources available to the Commission have been used for the work on the compendium. These include various sets of declarations submitted by Iraq, reports of inspections conducted by both UNSCOM and UNMOVIC, notes of discussions and interviews with Iraqi personnel, documents provided by Iraq and those found independently by inspectors during the course of inspections (including those originating from forensic computer exploitation), suppliers, overhead imagery, and information provided to the Commission by Governments.

270. Much of the data provided by Iraq to the United Nations, in terms of production of agent, weaponization, and usage was stated to be estimates or based on other information from recollection. Such uncertainties do not contribute readily to a full "material balance" approach whereby raw materials, inputs and production can be balanced against usage, waste, destruction and remaining stocks. The imprecise data related to production and weaponization lead to a "residue of uncertainty" in the overall verification results.

271. The lack of precise data, according to Iraq, occurred because of the unplemented policy of unilateral destruction which included physical evidence of the past WMD programmes as well as supporting documentation. This policy hindered verification through the material balance approach. By using a number of techniques described in the summary, however, United Nations inspectors were able to fill many gaps and obtain what they believe is a reasonably comprehensive picture of the extent of Iraq's past WMD programmes although there are still some aspects which are not fully known or understood.

272. The compendium provides a detailed technical description and analysis of Iraq's past WMD programmes and explores the issues where uncertainty occurs. Highlighted through the compendium are the lessons learned through this unique inspection process. As the individual programmes differed in size, structure and achievements, the associated chapters in the compendium reflect these differences. A redacted version of the compendium is being prepared and it is planned to eventually become available in the future for wider access.